

The University of Adelaide

# Pearson Island expedition feasibility report

Prepared for the Government of South Australia Department of  
Environment Water and Natural Resources and the Australian  
Government Department of the Environment.

Dr Alice Jones & Prof. Bronwyn Gillanders  
University of Adelaide  
30<sup>th</sup> June 2016

## Table of Contents

---

<b>1. Cover letter from DEWNR.....</b>	<b>2</b>
<b>2. Executive Summary.....</b>	<b>3</b>
<b>3. Document Overview.....</b>	<b>5</b>
3.1. Purpose of this document .....	5
3.2. Proposed expedition.....	5
3.3. Terms and Abbreviations.....	7
<b>4. Background.....</b>	<b>8</b>
4.1. Background.....	8
4.2. Benefits of the proposed expedition.....	14
<b>5. Scope and Objectives .....</b>	<b>15</b>
5.1. Inclusions.....	15
5.2. Exclusions .....	15
5.3. Constraints.....	15
5.4. Assumptions .....	16
<b>6. Options.....</b>	<b>17</b>
6.1. Option 1 .....	17
6.2. Option 2.....	18
6.3. Option 3.....	23
6.4. Option 4.....	28
6.5. Option 5.....	36
6.6. Additional costs .....	38
<b>7. Comparison of options and recommendation .....</b>	<b>39</b>
7.1. Recommended Option .....	40
<b>8. Consultation list and expedition partners.....</b>	<b>42</b>
8.1. Partner organisations .....	42
8.2. Consultation list.....	43
<b>9. Addendums.....</b>	<b>44</b>
9.1. Potential to extend the expedition and carry out monitoring at additional State Sanctuary Zones. ....	44
9.2. Interest in undertaking terrestrial surveys on Pearson Island. ....	44
9.3. Detailed map of Western Eyre Commonwealth Marine Reserve. ....	45
9.4. Detailed map of Investigator Marine Park .....	46
<b>10. References .....</b>	<b>47</b>

# 1. Cover letter from DEWNR



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

REF: Feasibility report on Pearson Island expedition requested in 'The Annual Agreement for the Cooperative Management of Commonwealth Marine Reserves adjacent to South Australia', between the South Australian Department of Environment, Water and Natural Resources and the Australian Government Department of the Environment (Director of National Parks).

**Science Monitoring and Knowledge**

Department of Environment, Water and Natural Resources

GPO Box 1047  
Adelaide SA 5001  
Australia

Professor Michelle Waycott  
Principal Advisor Marine Parks  
Program Research Partnerships  
Chief Botanist

Ph: +61 8222 9416  
Email: michelle.waycott@sa.gov.au  
www.environment.sa.gov.au

Date: 30 June 2016

Attention: Director of National Parks

Please accept this report, which is a feasibility assessment for an expedition to South Australia's Pearson Island Sanctuary Zone and the Western Eyre Commonwealth Marine National Park Zone. This assessment is in fulfilment of a request outlined in *The Annual Agreement for the Cooperative Management of Commonwealth Marine Reserves adjacent to South Australia*, between the South Australian Department of Environment, Water and Natural Resources and the Australian Government Department of the Environment (Director of National Parks). The request follows identification of a potential opportunity for State and Commonwealth cooperation in undertaking monitoring and baseline data collection at two adjacent offshore marine protected areas: South Australia's Pearson Island Sanctuary Zone and the Western Eyre Commonwealth Marine National Park Zone. These two relatively large zones are located in the Great Australian Bight to the West of Eyre Peninsula. Offshore marine protected areas are difficult and expensive to access, however represent highly valuable components to both the State and Commonwealth representative marine protected area networks due to their relatively pristine condition and low levels of impact due to anthropogenic activities.

This report has been prepared by Dr Alice Jones at the University of Adelaide under the guidance of the Research Partnerships Program for the South Australian Marine Parks Program. As the Principal Advisor to the Research Partnerships Program I endorse the work presented and look forward to ongoing discussions regarding possible opportunities to find resources to achieve the outcomes identifies in this proposal.

We look forward to ongoing discussions.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'M Waycott'.

**Michelle Waycott**  
Chief Botanist, Department of Environment, Water and Natural Resources

## 2. Executive Summary

---

This feasibility assessment has been undertaken in fulfilment of a request outlined in *The Annual Agreement for the Cooperative Management of Commonwealth Marine Reserves adjacent to South Australia*, between the South Australian Department of Environment, Water and Natural Resources and the Australian Government Department of the Environment (Director of National Parks). The request follows identification of a potential opportunity for State and Commonwealth cooperation in undertaking monitoring and baseline data collection at two adjacent offshore marine protected areas: South Australia's Pearson Island Sanctuary Zone and the Western Eyre Commonwealth Marine National Park Zone. These two relatively large zones are located in the Great Australian Bight to the west of Eyre Peninsula. Offshore marine protected areas are difficult and expensive to access, but potentially extremely valuable in terms of their contribution to both the State and Commonwealth representative marine protected area networks.

*The Agreement* indicated the need for a feasibility assessment for a field study to the Pearson Island area. To develop the assessment all available data were collated on the current state of knowledge for each zone and used to identify knowledge gaps. Discussions with both the State and Commonwealth management agencies were undertaken to ascertain the management and monitoring priorities for each zone.

This report contains proposals for five potential options for an expedition to the areas of protected waters surrounding Pearson Island. The options have been designed to achieve, as much as is feasible, the priorities highlighted in the zone management plans (where available) or to contribute baseline data and fill knowledge gaps to support the development of management plans and/or performance monitoring.

During the feasibility assessment process, it was identified that it would not be practical for such a trip to be undertaken in 2016/17 because of the significant lack of lead-time for planning, preparation and to source required funding. All of the options outlined in this report are based on the trip being undertaken in the 2017/18 financial year, within the period of March to May (to fit in with the best weather conditions). It has also become clear that the collection of data from a significant proportion of the Western Eyre Marine National Park Zone is technically impractical due to the extensive area (57,946 km<sup>2</sup>) and depth profile (average depth is approximately 80 m) and the constraints associated with the availability and affordability of vessels and equipment capable of working at such depths.

The conclusion of the report is a recommendation to undertake Option 4: *Inventory habitat mapping and BRUV surveys within Pearson Island Sanctuary Zone and Western Eyre Marine National Park Zone*. This option was selected over the other options as it is deemed to provide the best suite of data for the most reasonable price. Option 4 contributes significantly to the collection of ongoing monitoring data for the South Australian Marine Parks Program with the additional expenditure providing expanded surveys into the National Marine Park Zone. The expansion of sampling to include additional datasets from a larger area within the Commonwealth Western Eyre National Marine National Park is the most significant benefit gained from choosing this option.

Option 4 includes:

- Video-drop inventory habitat mapping across the majority of the Sanctuary Zone.
- Video-drop inventory habitat mapping along two transects (east-west and north-south) bisecting the Marine National Park Zone.
- BRUV diversity, abundance and biomass surveys of fish and other fauna from both zones.
- Geo-swath data collection for the generation of detailed maps of the bathymetry and seafloor features found within an area totalling ca. 30 km<sup>2</sup> in each zone (0.05 % of the Marine National Park Zone and 18 % of the Sanctuary Zone).
- Deployment of an array of five 'listening stations' (acoustic receivers), to detect the presence of animals tagged with acoustic devices. Regional tagging programs have targeted iconic marine megafauna such as white sharks (threatened), dusky sharks and bronze whaler sharks.
- Connectivity sample collection from a range of fauna at varying trophic levels within the Sanctuary Zone, the Marine National Park Zone and from unprotected waters.
- Collection of seagrass habitat status assessment data in partnership with the Environment Protection Authority
- Underwater and aerial imagery, an expedition blog and social media activity.

The cost of the expedition itself, as outlined in Option 4, is estimated at \$97,153.15. With an additional expenditure of approximately \$87,000 it would be possible to deliver high quality outputs through the collation, analysis, integration and publication of the expedition outcomes.

Option 4 involves four partner organisations and significant in-kind contributions from each, as well as a potential cash contribution of up to \$5,000 from the EPA and \$30,000 from DEWNR. Carrying out the expedition outlined in Option 4 would require additional funding of \$62,153.15, outside of the amounts already committed. A further \$87,000 would be required in order to analyse, synthesise and publish the outcomes.

## 3. Document Overview

---

### 3.1. Purpose of this document

The purpose of this document is to present an initial evaluation of the potential options available for undertaking a boat-based research and monitoring expedition to the South Australian State Pearson Island Sanctuary Zone and the adjacent Western Eyre Commonwealth Marine National Park.

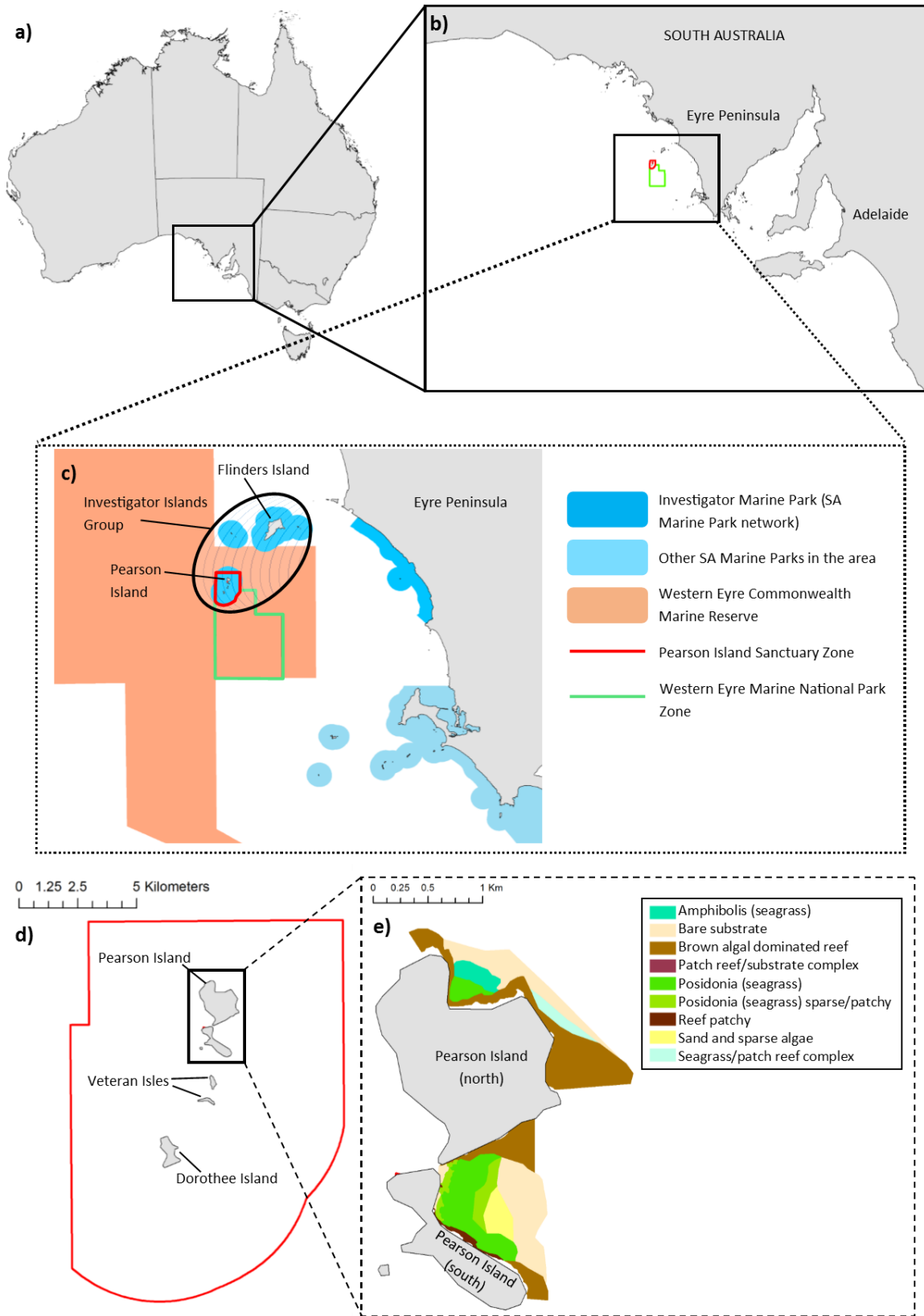
### 3.2. Proposed expedition

Pearson Island is part of the Investigator Group of Islands and lies within the Pearson Island Sanctuary Zone of South Australia's Investigator Marine Park (see map in Addendum 8.4). The Commonwealth's Western Eyre Marine National Park lies directly south of the State's Sanctuary Zone (within the Western Eyre Commonwealth Marine Reserve, see map in Addendum 8.3), providing an opportunity to undertake baseline research and/or core monitoring in both of these zones during the same expedition (see figure 1).

As part of the *Annual Agreement for the Cooperative Management of Commonwealth Marine Reserves adjacent to South Australia* (ref: DNP-MD-1516-002), the South Australian Department of Environment Water and Natural Resources (DEWNR) was tasked with the preparation of a feasibility study, to be delivered in June 2016, for a research and monitoring expedition to Pearson Island.

This analysis has been undertaken by marine research staff at the University of Adelaide with assistance from the Marine Parks Performance Team at DEWNR and input from staff at Parks Australia Marine Protected Areas Branch.

The preferred and proposed solution to get best-value from the expedition is option 4, which has an estimated cost of \$97,153.



**Figure 1:** Location maps. a) Map of Australia – black box shows area displayed in b) map indicating the general location of the South Australian Pearson Island Sanctuary Zone (red outline) and Western Eyre Commonwealth Marine National Park zone (green outline) in offshore waters to the west of Eyre Peninsula. c) Map of the waters to the west of Eyre Peninsula with State and Commonwealth marine protected area networks shown by shading. d) Zoomed in map of the Pearson Island Sanctuary Zone (red outline) containing the 3 Pearson Isles. Boxed area is shown in greater detail in e) Current extent of mapped marine habitat within the Pearson Island Sanctuary Zone.

### 3.3. Terms and Abbreviations

<b>Term/Abbreviation</b>	<b>Meaning</b>
DEWNR	Department of Environment, Water and Natural Resources, South Australia
Sanctuary Zone	Pearson Island Sanctuary Zone
Marine National Park Zone	Western Eyre Marine National Park Zone
EPA	Environment Protection Authority
IUCN	International Union for Conservation of Nature
BRUV	Baited Remote Underwater Video
MRV	Marine Research Vessel
Geo-swath	Collection of simultaneous high-resolution bathymetry (depth) and side-scan sonar (seabed features and texture) data using a multibeam echosounder.



## 4. Background

---

### 4.1. Background

#### Location:

The Pearson Isles form the southern-most part of the Investigator Group of islands; an archipelago located within South Australian waters in the Great Australian Bight (figure 1 a-c). The Pearson Isles group includes Pearson Island, the North and South Veteran Islands and Dorothee Island (figure 1 d). Pearson Island is located at the north of the group and is the largest of the four islands. It is approximately 63 km west-southwest of Cape Finniss on the Eyre Peninsula and around 25 km southwest of the largest island in the Investigator group; Flinders Island (figure 1 b & c).

The southern border of the Pearson Island Sanctuary Zone makes up the northern border of the Commonwealth's Western Eyre Marine National Park (figure 1 b & c). Visiting remote offshore marine protection zones is time-consuming and costly for management bodies. The proximity of these two zones makes it practical and cost-effective for the State and Commonwealth to collaborate on monitoring and data collection activities within these zones.

#### Pearson Island protected status:

Pearson Island is a very spectacular, unique and untouched wilderness. It is remote and pristine and as such is a key reference area for the State government marine parks program. The iconic status and conservation value of Pearson Island is evidenced by a number of environmental designations and protection orders dating back as far as 1916, highlighting the historical importance of the area within the National Parks and Wildlife South Australia program. The land area of the uninhabited Pearson Isles are protected within the [Investigator Group Wilderness Protection Area](#), which was proclaimed in 2011 on the basis of the lack of human impacts and high degree of environmental intactness in the area (i.e. no clearing or agriculture and few introduced species). The wilderness protection designation also recognises the importance of the islands to a number of marine megafauna including the Australian sea lion, long-nosed fur seal (previously known as New Zealand fur seal) and notable populations of seabirds of conservation significance.

Pearson Island, along with all of the other islands within the Investigator Group, are also encompassed by the [Investigator Islands Important Bird Area \(IBA\)](#), which was designated by Birdlife International in 2009. IBA status was determined by the importance of the archipelago to Cape Barren geese (supporting more than 1% of the global population) and fairy terns, which are listed as Vulnerable by the International Union for Conservation of Nature (IUCN). The islands were also recognised for being breeding sites for large numbers of short-tailed shearwater, white-faced storm petrel, little penguin, black-faced cormorant and Pacific gull.

All four of the Pearson Isles are protected within the Pearson Island Sanctuary Zone (SZ-2) of the Investigator Marine Park (Marine Park 4), which is part of the South Australian Representative System of Marine Protected Areas (part of this network is shown in figure 1 c). The Pearson Island Sanctuary Zone was designated on the basis of the exceptional conservation significance of the area. The Sanctuary Zone establishes a high-level of protection by prohibiting all types of fishing and collection of marine animals, plants, seagrass or shells. It is approximately 166 km<sup>2</sup> in size, representing around 14 % of the total area of Investigator Marine Park.

Western Eyre Marine National Park protected status:

The Western Eyre Commonwealth Marine Reserve encompasses a large area of 57,946 km<sup>2</sup>, within which the Western Eyre Marine National Park zone covers 17,439 km<sup>2</sup> (green outlined area in figure 1 b & c). The major conservation values listed for the entire reserve area include important foraging areas for a number of threatened marine megafauna such as Australian sea lion, white shark, blue whale, sperm whale, short-tailed shearwater and Caspian tern. In addition, the reserve encompasses key ecological features such as the Eyre Peninsula upwelling, meso-scale eddies, high-diversity benthic invertebrate communities and important areas for small pelagic fish (Director of National Parks 2013). There is no information currently available on the specific conservation features within the area of the Western Eyre Marine National Park Zone.

State marine parks program logic:

The main objective of the State marine park monitoring, evaluation and reporting (MER) program is to assess the effectiveness of the marine parks network for achieving the aspirational goal of the marine parks program, which is to sustain a *healthy, diverse and productive marine environment for future generations*. In order to achieve this goal, a number of immediate and intermediate protection- and performance-based outcomes have been outlined by DEWNR for the marine parks program.

The performance of the State marine parks is to be assessed using critical ecological information to inform the review of the marine park management plans and record any change in the ecological and socio-economic value of the designated areas (Bryars et al. 2016). Measuring change in these values requires both baseline data and ongoing monitoring of ecological indicators, drivers of change and human-mediated pressures over time.

One of the key protection-based outcomes of the State marine parks program is the enhancement of ecosystem status, function, connectivity and resilience through increasing or maintaining recruitment. This outcome is dependent on the protected areas within the network acting as sources of recruitment and biodiversity for the broader marine environment. Assessing the effectiveness of the marine park management plans for delivering this outcome will require a better understanding of the connectivity between the SARSMPA, the broader National Representative System of Marine Protected Areas (NRSMPA) and the surrounding unprotected waters.

Commonwealth marine reserves program logic:

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), management plans must be developed for proclaimed Commonwealth Marine Reserves. There are five Commonwealth Marine Reserve Networks, although currently only one of these (the South-east Commonwealth Marine Reserve Network) has an active management plan in effect. An independent review of the zoning and management arrangements for Commonwealth Marine

Reserves was completed in December 2015 and is currently being reviewed by the Government. Once review is complete, the marine reserve management authorities will begin preparing new management plans for the four regional networks that are awaiting active management.

The goal of a marine reserve management plan is to provide for the protection and conservation of the marine reserves. Management plans will have a maximum life span of 10 years and must set out how the reserves are to be managed. The South-west Marine Reserve Network, which contains the Western Eyre Marine Reserve and National Park, does not currently have a management plan in effect. Until such time as a management plan does come into effect, the reserve is operating with transitional management arrangements in place. This effectively means that there are no changes to on-the-water activities within the reserve. The lack of a current management plan for the Western Eyre Commonwealth Marine Reserve means that no management strategy or priorities have been identified for the Western Eyre Marine National Park Zone.

#### Current state of knowledge and knowledge gaps for Pearson Island Sanctuary Zone:

Macroalgal community structure, species diversity and biomass have been surveyed by divers at seven sites around the coast of Pearson Island, to depths of up to 30 m (Baker et al. 2008). Surveys were first undertaken in 1969 by Shepherd and Womersley (1971), who found that the clear water around the island enabled algal growth down to more than 50 m depth. Subsequent surveys were carried out by SARDI in 1993 (Edyvane 1999) as well as during the Royal Society of South Australia's 2006 expedition to the Investigator Islands. The cover of canopy-forming macroalgae is an important indicator of subtidal reef condition in South Australia (Collings et al. 2008; Gaylard et al. 2013). All of the previous studies reported remarkably high levels of macroalgal productivity and canopy species richness, as well as over 80 different species of understory macroalgae (summarised in Baker et al. 2008); suggesting a high conservation value of the waters surround the island. This exceptional diversity is due to a combination of regionally high biogeographic algal diversity and the clarity of the water locally, which allows high levels of light penetration. Collection of further data on macroalgal communities through the Sanctuary Zone would contribute to the existing time series of observations dating back to 1969 (Shepherd et al. 1971). This would allow detailed analyses of the temporal stability of macroalgal assemblages through time, as well as the factors influencing this stability at a site without anthropogenic impacts but subject to natural disturbances (Baker et al. 2008).

There are large areas of highly diverse seagrass communities within the Pearson Island SZ, some of which reach depths of up to 30 m, which is unusual within South Australia (Bryars et al. 2008; Miller et al. 2008). Previous surveys have identified at least ten different species of seagrass from within the more sheltered areas to the east of the island, where meadows of *Posidonia* were noted as being particularly extensive (Bryars et al. 2008; Miller et al. 2008). There have been a number of dive-based surveys of seagrass distribution, diversity and biomass within Pearson Island Sanctuary Zone. If further survey data can be collected during an expedition to the area, there is potential for a robust investigation into changes in the distribution and condition of this habitat over time, including looking for evidence of positive effects of the Sanctuary Zone protections.

Sponge and sessile invertebrate communities were surveyed within the Sanctuary Zone during the 2006 expedition using quadrats set along transects in shallow water (~ 5m). These organisms were found at low densities in quadrat surveys of the benthos, however extremely rich communities were discovered on overhangs and in small caves in rocky reef habitats (Sorokin et al. 2008). These communities included a particularly wide variety and abundance of ascidians and sponges as well as sea fans. The authors noted that the level of diversity in the sessile invertebrate fauna merited protection and further study (Sorokin et al. 2008). They also highlighted the potential for drug discovery from sponges and marine algae, which is a topic currently being investigated through collaborative research between Flinders University and the University of Adelaide. An expedition to the islands could potentially contribute to this research by the collection of specimens from the diverse marine ecosystems within the Pearson Island Sanctuary Zone.

Broad-scale benthic habitat mapping has been undertaken in a small area of the Pearson Island Sanctuary Zone using manual digitisation based on video drop surveys (Miller et al. 2008). The mapped area is along the eastern side of Pearson Island (figure 1 e) and covers approximately 2 km<sup>2</sup>, which constitutes around 1.2 % of the area of the Sanctuary Zone. The benthic communities identified within the mapped area include dense seagrass beds, bare sand and macroalgal communities associated with rocky reefs.

There are also some habitat classification data available from a benthic habitat map generated by Bryars (2003). This map is considered to be less reliable as it is based on aerial photographs, topographic maps, literature and local knowledge. This map identifies two broad-scale habitats within the Pearson Island Sanctuary Zone; seagrass meadows (ca. 0.6 km<sup>2</sup>) and reef and unvegetated soft bottom (ca. 3.1 km<sup>2</sup>). Together the habitats delineated by Bryars (2003) cover an area of approximately 2 km over-and-above what is covered by the higher-resolution mapping by Miller et al. (2008).

Fish species surveys have been undertaken at least 8 different reef habitat sites within Pearson Island Sanctuary Zone (in shallower waters close to the island) during the 2006 expedition and by the Reef Life Survey organisation in 2014. The data are not available from all of these surveys, however at least 39 different species of reef-associated fish were recorded during the Reef Life Survey dives in 2014.

There are a variety of large marine species recorded in the waters of the Investigator Marine Park (Bryars et al. 2016). Many of these species are likely to use the Pearson Island Sanctuary Zone, but there is currently little direct evidence of this for the majority of these species. Pearson Island is a known breeding site for the Australian sea lion (IUCN status: Endangered) and long-nosed fur seal (Goldsworthy et al. 2009). It is also a breeding site for little penguin and the waters around the island have been shown to be important foraging ground for adult birds provisioning for their young (Goldsworthy et al. 2010).

**Table 1:** List of the marine megafauna noted as being present within the Investigator Marine Park (Bryars et al. 2016). Note that this list is not exhaustive and not all of these species will necessarily occur with the Pearson Island Sanctuary Zone.

<b>Sharks</b>	<b>Seabirds</b>	<b>Shorebirds</b>	<b>Marine Mammals</b>
Bronze whaler	White-bellied sea eagle	Pied oystercatcher	Southern right whale
Dusky whaler	Osprey	Sooty oystercatcher	Australian sea lion
Blue shark	Fairy tern	Hooded plover	Long-nosed fur seal
Smooth hammerhead	Little penguin	Grey plover	Common dolphin
School shark	Pacific gull	Common greenshank	Bottlenose dolphin
White shark	Short-tailed shearwater	Eastern curlew	
Shortfin mako	White-faced storm petrel		
Porbeagle	Pied cormorant		
Gummy shark	Caspian tern		
	Silver gull		

According to the best-available bathymetry data (with a resolution of ca. 250 m<sup>2</sup>), the average depth in the Pearson Island Sanctuary zone is 68.15 m and the maximum depth is ca. 90 m.

*Knowledge gaps for the Pearson Island Sanctuary Zone include:*

- All five of the marine habitat types defined in the Investigator Marine Park baseline report (reef, seagrass, sand, mangrove and saltmarsh) appear to be under-represented within the SA marine park. However much of the subtidal area of the marine park (~ 92 %) is unmapped. The report identified that additional mapping information will improve the understanding of the comprehensiveness and representativeness of the Investigator Marine Park and the broader South Australian Representative System of Marine Protected Areas.
- The habitat mapping work that has already been undertaken (Bryars 2003; Miller et al. 2008) represents a great improvement on what was previously available, however it covers less than 3 % of the total area of Pearson Island Sanctuary Zone and is limited to a small zone around the coast of Pearson Island. There are no data on the habitats present outside of this small area.
- There is no quantitative data available on the shoreline habitats present on any of the offshore islands within the Investigator Marine Park.
- There are no data available on the diversity of mobile invertebrates and infauna. In addition, the surveys that have been done on sessile invertebrates cover a limited area of the Sanctuary Zone in shallow depths (~5 m).
- There is a general lack of understanding of the level and scale of genetic and ecological connectivity, both within the State marine parks network, and between the State and Commonwealth networks. Further investigation of this is imperative in order to validate the basis of the state and national networks, to ensure that an optimum design has been achieved and to demonstrate the potential benefits of the marine park and reserves

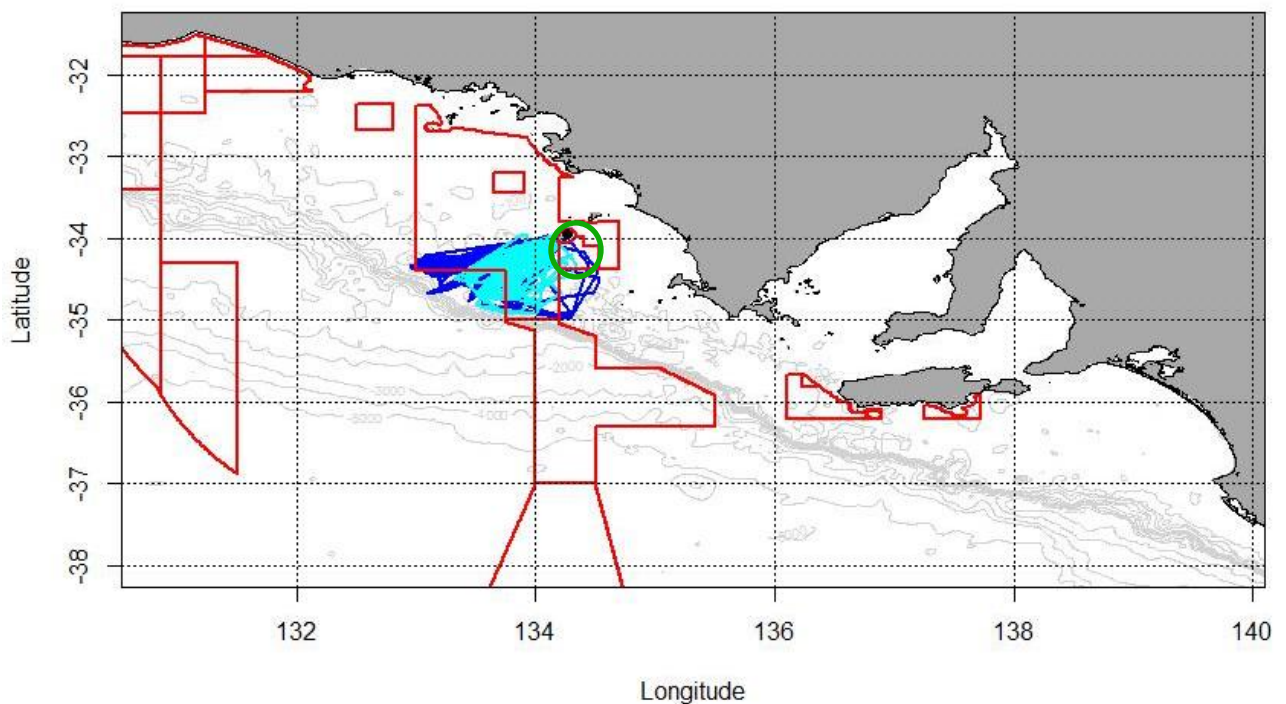
programs to the wider marine environment through source-sink dynamics and overspill into unprotected waters.

- Although some survey and tracking work has been undertaken with the sanctuary zone for pinniped and seabird species that breed or rest on land, there is a paucity of information on the occurrence, distribution and use of the sanctuary zone by sharks and cetaceans.

Current state of knowledge and knowledge gaps for Western Eyre National Park Zone:

It appears that very little is currently known about the habitats and species within the Marine National Park Zone. Collection of baseline data from this area should be a priority, as this will provide valuable information for the future development of a management strategy.

Evidence from tracking studies of Australian sea lions from the Pearson Island colonies shows that the waters of the Commonwealth Marine Park are used for foraging during the breeding season (figure 2, S. Goldsworthy, personal communication). A similar pattern has been shown for little penguins foraging during the breeding season (Wiebkin 2012).



**Figure 2:** Tracks of male Australian sea lions from the Pearson Island breeding colonies. Pearson Island Sanctuary Zone and Western Eyre Marine National Park Zone are indicated by the green circle. Note that the tracks indicate that the Western Eyre Marine National Park Zone is used for foraging and travelling. Data provided by Prof. Simon Goldsworthy (unpublished).

Knowledge gaps for the Western Eyre Marine Reserve include:

- The Commonwealth marine protected area network seeks to achieve a number of goals in order to maximise conservation outcomes. One of these goals is to include examples of many benthic/demersal biological features (for example, habitats, communities, sub-regional ecosystems, particularly those with high biodiversity value, species richness and endemism), as well as including areas representing all of the 21 different types of seafloor features found across the entire Exclusive Economic Zone. The Western Eyre Marine

National Park Zone is far offshore, relatively deep, and has not been the subject of detailed study or data gathering (Director of National Parks 2013). Therefore the knowledge of the benthic habitats and overall biodiversity existing within it is not well developed.

- In order to assess the contribution of the Western Eyre Marine National Park Zone to the overall goals and representativeness of the broader National Representative System of Marine Protected Areas, it is critical that we gain a better baseline understanding of the conservation values of the designated area in terms of the occurrence and distribution of sediment types and other geo-oceanographic variables, benthic habitats and ecologically important pelagic features and aggregations of threatened and/or migratory species.
- There is very little knowledge of the importance of the zone to local and migratory marine megafauna species such as seabirds, sharks and marine mammals.

## **4.2. Benefits of the proposed expedition**

The proposed expedition would benefit both the State and Commonwealth marine protected area programs.

The expedition has the potential to collect important core monitoring and habitat mapping data from within the Pearson Island Sanctuary Zone, much of which has not previously been surveyed. In areas of the Sanctuary Zone that already have some data available, the trip will provide the opportunity to develop the current level of understanding of the habitats and species present and to look at temporal dynamics. Undertaking such a research and data collection trip is a significant investment and in the current economic climate would require an innovative and collaborative approach to in order to acquire adequate funding.

The data collected would provide essential baseline information about benthic habitats and both benthic and pelagic species diversity within the Western Eyre Marine Reserve National Park Zone, for which there are no existing data. These data will be extremely valuable during the ongoing process of developing and refining the management plan for the reserve. In addition they will provide a reference point from which to assess future changes to the marine environment within the reserve.

Collection of data for connectivity studies from both the State and Commonwealth zones would contribute to a broader understanding of the effectiveness of the protected area networks and may provide key evidence for local linkages between the State and Commonwealth zones. Genetic and isotopic analyses on tissue samples from a range of species at different trophic levels would also contribute to broader studies on the connectivity between, and effectiveness of, marine protected areas. The results of these studies may provide answers to questions about how marine reserve effectiveness varies with biological, and physical factors such as distance from other protected areas.

## 5. Scope and Objectives

---

There were no clear terms of reference or scope set out for this feasibility report in *The Annual Agreement for the Cooperative Management of Commonwealth Marine Reserves adjacent to South Australia*. The definition of this task, as written in *The Agreement* was “Preparation, planning and feasibility study for 2016/17 monitoring expedition to Pearson Island”.

The following objectives have been defined by the authors:

- Provide background and context for the feasibility report.
- Assess options for a range of core monitoring, baseline data collection and research activities that may be undertaken during the proposed expedition to the Pearson Island Sanctuary Zone. These activities should be consistent with the goals and strategies of the State marine parks program.
- Identify opportunities for the trip to benefit the South-west Commonwealth Marine Reserves Network, by undertaking baseline data collection within Western Eyre Marine National Park Zone.
- Identify the costs involved in undertaking the different proposed expedition options, and where possible, identify potential sources of cash and in-kind contributions from DEWNR Marine Parks, Parks Australia and through partnering with other organisations and institutions.
- Make a recommendation for a preferred option, with justification.

### 5.1. Inclusions

Planning and costing multiple options for carrying out the expedition, including a ‘do nothing’ option, a basic survey option and various value-add options with costs and benefits outlined.

### 5.2. Exclusions

- 1) Sourcing the required funds for undertaking the expedition, although some comments have been made about potential funding partnerships with a view to generating a collaborative funding approach.
- 2) After consideration, it was decided to exclude monitoring marine mammals and seabirds from the scope of this proposal. This is because the timing of the trip does not correspond to the breeding season of the main species of interest: Australian sea lions, long-nosed fur seals or little penguins. As such, it would not be possible to undertake effective population monitoring such as pup-counts for the pinnipeds or occupied burrow/chick counts and individual marking for the penguins.

### 5.3. Constraints

- 1) At present there is a significant gap between the required funding for the expedition and the secured funding, even for the most basic science program option (option 2). The total amount of funding sourced so far is \$35,000 (\$30,000 from DEWNR and \$5,000 provisionally from the EPA). The deficit in confirmed funding is between \$10,660 and \$98,277 (depending on the option selected).



- 2) A boat-based expedition would need to take place during the months of March to May so as to be most likely to coincide with the calmest sea conditions. This would ensure the best possible chance of reducing the amount of time lost to poor weather during the expedition (but would not guarantee that no time was lost).
- 3) It is considered unfeasible that this trip take part in the 2016/17 financial year due to the short lead-time for planning, preparing and funding. In addition, the DEWNR Marine Parks Performance Team and their equipment would potentially not be available during this time because of other planned monitoring activities. Sourcing external expertise and equipment to replace this team would be unfeasibly expensive. It is proposed that the trip be undertaken during the 2017/18 financial year, specifically between March and May 2018. This timing would allow adequate time to effectively plan, seek co-funding from external agencies and would fit in better with existing monitoring plans for the south-west offshore islands of the State's marine park network.
- 4) The lack of an active management plan for the South-west Commonwealth Marine Reserves Network (and the Western Eyre Commonwealth Marine Reserve within in) is a significant constraint to the report. Without a strategic management plan, it is unclear what the objectives and goals of the Western Eyre National Park Zone are and therefore what the key monitoring priorities should be for any work undertaken in the National Park Zone during this trip.
- 5) The lack of a specific scope and defined objectives for the expedition within *The Agreement* is a constraint on this feasibility study.

#### **5.4. Assumptions**

There are five main assumption of this feasibility report:

- 1) The trip will be allocated \$30,000 from the annual Commonwealth funding for the State's marine parks program in the 2017/18 financial year. Further funding will have to be sourced in order for the expedition to take place.
- 2) The DEWNR Marine Parks Performance Team will be available to take part in the trip and undertake any work that contributes significantly to core monitoring activities for the State's marine park program.
- 3) The DEWNR Marine Parks monitoring equipment will be available to take on-board the MRV Ngerin for the duration of the expedition, although cost-recovery may be necessary when data being collected don't directly contribute to the Sanctuary Zone core monitoring.
- 4) The MRV Ngerin will be able to operate during the night in order to facilitate longer periods of science work and the collection of swath mapping data. This work will also require 1-2 science staff to be available to work at night in order to supervise data collection.
- 5) The MRV Ngerin will be secured for the duration of the trip and will be costed at internal rates (\$3,600), as previously agreed for DEWNR contracts. This has been confirmed verbally with the vessel management, based on any contract being drawn up with DEWNR, rather than one of the other science team members (i.e. Commonwealth or University). If the vessel is charged at the external rate, this will cost \$6,900 per day and would add considerably to the estimated costs in this report. The vessel is currently available for the period March – May 2018.

## 6. Options

---

### 6.1. Option 1

#### Do Nothing

##### 6.1.1. Advantages

- Short-term cost saving.
- The potential for funds to be re-directed into other parts of the State and Commonwealth marine park programs.
- More time to plan and secure external funding contributions for undertaking this trip at some point in the future.

##### 6.1.2. Disadvantages

In the medium to long term, there are significant benefits to carrying out the expedition because of the amount of data that would be collected from a remote, offshore area, which is difficult to access. Pearson Island is a priority sanctuary zone in the State marine park monitoring program. Both the State and Commonwealth zones will need to be visited at some point in the near-future in order to fulfil the State and Commonwealth marine and national parks obligations under the Marine Act.

The risks of maintaining the status-quo in terms of the level of baseline and monitoring data from the State and Commonwealth marine protected zones are listed below:

- Lack of understanding of the biological assets within the designated protected areas and thus a lack of knowledge of the overall efficacy of the Commonwealth and State networks at protecting representative areas of marine habitats.
- A significant risk that core monitoring will not be undertaken in the Pearson Island Sanctuary Zone in this monitoring cycle because of the expense of getting to the area and a shortfall in funding resources.
- Lack of baseline and monitoring data, from both the State and Commonwealth Zones, to use for comparison against future monitoring data and therefore a reduced ability to demonstrate the effectiveness of any management plans or to detect change into the future as a result of management actions.

##### 6.1.3. Recommendation for option 1

This option is not recommended as the disadvantages of doing nothing in this case far outweigh the advantages.

## 6.2. Option 2.

### **Core monitoring within Pearson Island Sanctuary Zone.**

This option is based around a 9-day expedition to the Pearson Island Sanctuary Zone on-board the MRV Ngerin, to take place during the period March-May 2018 (based on the best time of year for weather and sea conditions). This option involves 8 science staff:

- 6 staff from DEWNR Marine Park Performance Team (dive team of 4 and BRUV team of 2, with additional geo-swath and drone operation capabilities within this group).
- 2 researchers from the University of Tasmania (dive support).

There is additional space on-board the research vessel, however this option currently only includes the minimum number of staff required to undertake a basic science plan. There is scope within this option for more science staff to join the expedition as long as funding could be secured to cover their travel and that their scientific aims could be achieved without impacting on the schedule of work set out in the expedition's science plan.

The 9-day time period includes travel for both the vessel and science staff from Adelaide to the Pearson Island Sanctuary Zone and back. A total of 6 days of science data collection are included (5 full days and 2 half days). This option is the minimum time period that has been considered in this report. Anything less is not deemed long enough to achieve adequate data collection to be a cost-effective use of resources. This option involves the vessel travelling separately from the 8 science staff. This saves on science staff time requirements as the vessel transit time is considerably longer than travelling by plane from the mainland to Flinders Island, where there is a landing strip and mooring for the research vessel. This option currently assumes that all science staff will remain on-board the vessel for the 6-day duration of the scientific program.

### **Science program:**

- MRV Ngerin total transit time = 3 days, 1.5 days at each end of the trip. This time allocation is based on approximately 26-hrs steaming each way, plus time to collect/drop off science team at Flinders Island and on-site preparation/demob for science work.
- DEWNR marine parks program core monitoring dive surveys. Diving will be carried out directly from the Ngerin. There is no scope for bringing a separate, smaller boat to dive from (e.g. DEWNRs boats), because these are not certified to operate in waters so far offshore. It may be possible to dive from small tenders kept on-board Ngerin and deployed over the side, but this will require a member of the Ngerin crew to skipper the tender and will depend on their availability/shift patterns. Divers will undertake line transect surveys and will record fish species and abundance (200 x 10 m strip), invertebrate species and abundance (200 x 2 m strip) and information on habitat type and macroalgae (80 photo quadrats). Dive surveys will be undertaken at eight dive sites (four inside and four outside the sanctuary zone). This work requires a team of six (4 DEWNR Marine Park Performance Team staff and 2 University of Tasmania staff). Total time required to complete this work = 3 days.
- DEWNR core monitoring benthic BRUV surveys at six sites (three inside and three outside the sanctuary zone), with four replicate drops at each site. Stereo BRUV systems will be used to survey species diversity and size (for biomass estimates). Each BRUV system is deployed for one hour. This work requires a team of two DEWNR Marine Park Performance Team staff. Total time to complete this work = 3 days.

- Fish trapping for connectivity studies to be undertaken concurrently with BRUV deployments within the Sanctuary Zone (at nearby sites, but far enough away not to affect BRUV survey) and in the evening/overnight at sites within the Marine National Park Zone. Requires a team of two and can be undertaken opportunistically to fit in around the core monitoring work. This work will secure samples from multiple trophic levels from benthic and mid-water habitats, both inside the Sanctuary Zone and the Marine National Park Zone, as well as within nearby unprotected waters. This work relies on fish traps being supplied on-board the MRV Ngerin.
- Collection of seagrass, macroalgae and invertebrate fauna (grazers and predators) for connectivity studies, to be undertaken opportunistically during dive surveys (no additional time allocation for this task is possible). This will secure samples from multiple trophic levels from depths of around 5m (corresponding to the standard depth of the dive surveys), from sites both inside and outside the Sanctuary Zone. This work cannot be undertaken in the Marine National Park Zone because it is too deep to dive there.
- Collection of aerial video and still imagery of Pearson Island using a drone. To be undertaken by 1 member of the science team while dive surveys are being undertaken close to the island (no additional time required).
- Collection of underwater video and still imagery during dive surveys by the dive team (no additional time required).
- Collection of swath bathymetry and backscatter data throughout the night. This will require vessel crew to work on shift in order to achieve 24-hour data collection capabilities on-board the MRV Ngerin. It has been confirmed that this is achievable. There are great benefits to being able to work at night as this effectively doubles the amount of time available for collecting scientific data and enables swath mapping coverage of an area of approximately 5 -6 km<sup>2</sup> per night. This means that over the 6 days that the vessel is within the Sanctuary Zone, it is possible to collect ca. 30 – 36 km<sup>2</sup> of high resolution data for habitat mapping (covering around 20 % of the area of the zone). This requires 1-2 members of science staff to work on the night shift in order to supervise the collection of this data. Because this work can be done at night, it does not affect the rest of the science plan and does not add any cost to the trip.

**Estimate of cash contributions required: TOTAL = \$45,660.**

- MRV Ngerin charged at internal day-rate of \$3,600 (including 4 crew, on-board compressor, food and beverage supplies for crew and science team, accommodation for crew and science team of up to 12 people, fuel) for 9 days at sea and 2 x 0.5 day mobilisation and demobilisation = \$36,000.
- The science team will meet the MRV Ngerin at Flinders Island. Travel for the eight-person science team Adelaide - Flinders Island - Adelaide by plane (up to 9 passengers) flight time is approximately 1-hr). The estimated total cost for this item is \$6050.
- Fabrication of a new attachment pole for the geo-swath instrument and a rigid antennae pole. These area required in order to properly attach the instruments to the MRV Ngerin and prevent movement and/or interference from the vessel's funnel (which caused issues last time this vessel was used). The estimated total cost for this item is \$1,000.
- Satellite subscriptions are required in order to get accurate and precise positional information when undertaking the survey work. This will be required for the 6-days of

the expedition when survey work is being carried out. Based on a daily rate for this service of \$120, the estimated total cost is \$720.

- Purchase of a remote piloted aircraft (drone) for the collection of high-resolution aerial imagery of the Pearson Island Sanctuary Zone during the expedition. The aim is to achieve a record of the expedition and collect inspiring footage that clearly demonstrates the value of the Sanctuary Zone. This footage will be used to contribute to the State marine parks program objectives of increasing public appreciation of marine parks, supporting education, increasing positive media and an improved community understanding of sanctuary zones and their habitats. It is more cost-effective to purchase these items than to rent them as rental requires the mandatory hire of a drone-operator including their travel and accommodation costs. The estimated total cost for this item is \$1890 (see itemisation below):
  - Purchase of 3DR Solo quadcopter = \$1400.
  - Purchase of a spare battery = \$220.
  - Purchase of 2 sets of propellers = \$50.
  - Purchase of carry case = \$220.
  - DEWNR has existing GoPro camera equipment that can be attached to an in-built 3-axis gimbal mount on the Solo 3DR quadcopter.
  - Free mission planning software is available.
  - Members of the science team have adequate experience piloting drones in order to collect the required footage.

**In-kind contributions from DEWNR: Total = \$86,743.75**

- Staff salary for 20 days of preparation and planning in the run-up to the expedition (trip planning, logistics, equipment preparation, instrument calibration before and after trip, OH&S, organising permitting and preparing on-board the vessel and demobilisation). Staff costed at \$840.75 per day (average level used: PO2) = \$16,815.
- Staff costs for science team during the expedition: 6 staff members x 7 days (1 travel day and 6 days on-board vessel). Staff costed at \$840.75 per day (average level used: PO2) = \$35,311.50.
- Staff dive allowance costs of \$40 per day for 4 DEWNR staff for 3 days = \$480.
- BRUV equipment (8 x stereo BRUVS) at \$75 per unit per day for the 9 days that the gear will be on-board the MRV Ngerin (including transit days) = \$5,400.
- Geo-swath instrumentation at \$1000 per day for the 9 days that the gear will be on the boat (including transit days) = \$9,000
- 40 full compressed air tanks for diving at \$10 per tank = \$400.
- Data-processing for BRUV surveys based on ca. 2-hrs of analysis per BRUV drop (24 BRUV drops x 2hrs = 48hrs). Staff costed at \$840.75 per day (average level used: PO2), for 7 days = \$5885.25.
- Data validation and processing for dive survey data based on ca. 1-hr per dive. Staff costed at \$840.75 per day (average level used: PO2), for 1 day = \$840.75.
- Data processing for geo-swath data based on 0.5 days per km<sup>2</sup> of data collected (total of up to 36 km<sup>2</sup> coverage). Staff costed at \$840.75 per day (average level used: PO2), for 15 days = \$12,611.25.

**In-kind contributions from University of Tasmania: Total = \$8,400**

- \$1400 per day for two people x 6 days = \$8,400.

**6.2.1. Technical Feasibility**

This option is technically feasible. The MRV Ngerin is well-suited to this type of work and has the appropriate equipment on board (e.g. fish traps, compressor). The DEWNR dive and BRUV teams and equipment are capable of the tasks required in order to successfully achieve the science program outlined above.

There is some risk as to whether the amount of work scheduled can be carried out within the allocated timeframe. This is because no time has been allowed for weather interruptions. If there were additional funds available, it would be sensible to build in at least one extra day to allow for interruptions to the program due to inclement weather.

**6.2.2. Advantages**

This option is the most basic science program that achieves enough monitoring and data collection in order for the trip to be considered worthwhile. The key advantages are that DEWNR can undertake their core dive and BRUV monitoring requirements for the Pearson Island Sanctuary Zone as well as collecting some high-resolution geophysical data for habitat mapping purposes. This option also achieves added-value through the collection of samples for a broader connectivity study, as well as underwater and aerial imagery to use in State Marine Parks promotional and education material.

The data collected whilst diving within the sanctuary zone can be compared to the data previously collected in the area. Dive transects will be placed to align with previous transect surveys, so that directly comparable data are collected. This enables an assessment of change through time for those components of the flora and fauna that were surveyed during previous visits.

**6.2.3. Disadvantages**

The major disadvantage of this option is that it does not allow any time for monitoring or data collection from within the Commonwealth's Western Eyre Marine National Park Zone. If the funds allowed, it would be extremely beneficial to extend the trip in order to be able to undertake inventory sampling within the Commonwealth area.

Whilst this option achieves the *minimum* requirements of the State marine parks monitoring program, it does not allow any time for collecting video data on the presence and distribution of marine habitats and species within the Sanctuary Zone.

The cost of the MRV Ngerin makes up the majority of the cost of the trip. A significant proportion of this cost is paying for travel time (ca. 30 %). The benefits of outlaying the cost of getting the vessel to the site would be increased if the duration of the trip could be extended in order to undertake a more extensive scientific program.

#### **6.2.4. Recommendation for option 2**

This option is not recommended as it does not achieve the best trade-off between the cost of travel and transit to the site (ca. 40 %) and the time spent on the science program (ca. 67 %). Consequently, the cost of getting the MRV Ngerin to the site makes up a significant proportion of the total budget and time required to carry out this option. In addition the short expedition duration does not allow for any work to be undertaken in the Commonwealth Marine National Park Zone.

### 6.3. Option 3.

#### **Core monitoring within Pearson Island Sanctuary Zone with BRUV-based baseline data collection carried out in the Western Eyre Marine National Park Zone.**

This option is based around a 12-day research expedition to the Pearson Island Sanctuary Zone and Western Eyre Marine National Park Zone on-board the MRV Ngerin, to take place during the period March-May 2018 (based on the best time of year for weather and sea conditions). This option involves 10 science staff. Not all staff will be on-board the vessel at the same time so as to reduce redundancy and in-kind/cost-recovery staff time requirements from each organisation:

- 6 staff from DEWNR Marine Park Performance Team (dive team of 4 and BRUV team of 2, with additional geo-swath and drone operation capabilities within this group).
- 2 researchers from the University of Tasmania (dive support).
- 1 researcher from the University of Adelaide (connectivity sample collection, support with inventory mapping in Commonwealth Marine National Park Zone, expedition blog).
- 1 staff from the Environment Protection Authority (EPA) (seagrass and water chemistry sampling and analysis).

There may be additional space on-board the research vessel, however this option currently only includes the minimum number of science staff required to undertake the science plan outlined below. There is scope within this option for more science staff to join the expedition as long as funding could be secured to cover their travel and that their scientific aims could be achieved without impacting on the schedule of work set out in the expedition's science plan.

The 12-day time period includes travel for both the vessel and science staff from Adelaide to the Pearson Island area, and back. A total of 9 days of science data collection are included (8 full days and 2 half days). This option includes all of the tasks set out in option 2, with additional baseline data collection within the Marine National Park Zone and seagrass monitoring work carried out by the EPA (with an associated cash contribution of up to \$5,000). The researcher from the University of Adelaide will be coordinating a blog with daily posts on the expedition for science communication and community engagement/education purposes.

This option involves the vessel travelling separately from the 10 science staff. This saves on science staff time requirements as the vessel transit time is longer than travelling by plane from the mainland to Flinders Island, where there is a landing strip and mooring for the vessel. This option includes two return charter flights, in order for DEWNR dive staff to leave the expedition once diving activities have ended and EPA/University of Adelaide staff to join the trip. This second flight means that there is also an opportunity for other researchers to join the expedition part-way through should there be interest in doing so. This enables scientists to undertake a few day's work within the science program without needing to be on-board the research vessel for the full trip duration, as long as their research can be undertaken without impacting on the schedule of work set out in the expedition's science plan for the latter part of the trip.

#### **Science program:**

- All items as outlined in option 2.
- Baseline data collection within the Commonwealth's Western Eyre Marine National Park Zone using midwater and benthic BRUV drops. The zone covers an extremely large area, therefore it is not considered to be feasible to undertake a full, strategic sampling



program within it. Midwater and benthic BRUVs will each be dropped at four sites within the Marine National Park Zone (these can be deployed at the same 4 sites or different sites for the mid-water vs the benthic surveys). Three replicates will be carried out at each site (total of 12 benthic BRUV and 12 midwater BRUV samples). The number of sites and replicates has been determined based on the amount of time it will take to complete this work. The placement of sample sites can be undertaken randomly, or along a transect parallel to the boundary between the National Park and Sanctuary zone (length of boundary = 15.7 km, sites distributed at ca. 2km intervals). The total time required to complete this work = 3 days.

- EPA seagrass monitoring work, involving water and seagrass sampling and video drop surveys at 3 sites within the Pearson Island Sanctuary Zone with depths of less than 15 m (sample sites may include sites previously sampled in 2014). It is preferable if this work can be undertaken from the Ngerin tender as it is easier to collect the water samples from a smaller boat. The standard EPA protocol for this work involves 10 water samples and 10 video drops (ca. 50 m) being collected from within each 20 ha sample site. This work takes ca. 1 hour per site and could be undertaken opportunistically at convenient times during the additional 3-days of science time included in this option. The video survey data from this work will be shared with DEWNR and therefore contributes to inventory mapping of the Sanctuary Zone.
- The extended trip duration allows for additional swath work to be carried out through the night on 3 more nights. This means that it is possible to swath an additional area of 15 – 18 km<sup>2</sup>. It is recommended that this time is spent covering a greater area of the Sanctuary Zone (bringing the total area covered up to around a third of the zone). This is preferred over collecting geophysical data from the Marine National Park Zone because only an extremely small proportion it can be covered in the time available. However, if it is decided that the extra swathing time be spent in the Marine National Park Zone, it will be sensible to focus on the area around the BRUV survey sites. This work does not require any additional time as it can be carried out through the night.
- The addition of an extra member of the science team means that there will be someone responsible for coordinating daily blog posts about the expedition. These will include updates on the science and monitoring work as well as photos and video (if possible with the vessel's internet connection).

**Estimate of cash contributions required: TOTAL = \$83,655.75**

- The cost as of option 2 = \$45,600.
- MRV Ngerin for an extra 3 days (at an internal day rate of \$3,600) = \$10,800.
- An additional return flight from Adelaide to Flinders Island (for up to 9 passengers) in order for 4 DEWNR staff (and possibly also the University of Tasmania divers) to leave the expedition and for additional researchers to join the expedition (if appropriate) = \$6050.
- Cost of the DEWNR benthic BRUV equipment for 3 days to carry out surveys in the Commonwealth Marine National Park (8 units charged at a rate of \$75.per unit) = \$1,800.
- Cost of 2 DEWNR staff to undertake benthic and mid-water BRUV surveys in the Marine National Park Zone. Staff costed at \$840.75 per day (average level used =PO2) for 3 days = \$5044.5.

- Fabrication of galvanised steel frames for mid-water BRUV systems, to be used in the Marine National Park Zone. The existing DEWNR BRUV frames are designed for benthic sampling and cannot be used for midwater surveys. It has not been possible to locate any researchers who are willing to loan this equipment to the expedition. Cameras can be loaned, either from University of Adelaide researchers, or from the DEWNR benthic BRUV systems. Cameras are depth rated to 150 m. To reduce costs, the number of mid-water BRUV systems has been limited to 4 (rather than 8). Total cost of fabrication of 4 mid-water BRUV frames (including camera mounts) at \$814 per unit (including GST) = \$3256.
- Cost of purchasing longer ropes and lights for the DEWNR benthic BRUV systems, so that they can be used in the deeper water of the Marine National Park Zone (average depth is > 80m). Light systems (LED, wide beam, with red-light options and mount) will cost approximately = \$1000 per BRUV unit. Ropes will cost approximately \$200 per BRUV unit (150 m). To reduce the cost of these items, the number of benthic BRUV units used for the deeper-water work will be reduced from 8 to 4 (the other 4 DEWNR BRUV systems on-board the vessel will be used to support the midwater BRUV work). Total cost of this item = \$4800.
- Cost of DEWNR staff time for data processing for BRUV survey data from the Marine National Park Zone, based on ca. 2-hrs of analysis per BRUV drop (24 BRUV drops x 2hrs = 48 hrs). Staff costed at \$840.75 per day (average level used: P02), for 7 days = \$5885.25.
- Additional 3 days of subscription for satellite positioning service (at a rate of \$120 per day) = \$360.

**In-kind contributions from DEWNR: Total = \$91,004.87**

- As per option 2 = \$86,743.75
- Geo-swath instruments for an additional 3 days, at \$1,000 per day = \$3,000.
- Data processing for an additional 3 nights of geo-swath data based on 0.5 days per km<sup>2</sup> of data collected. Staff costed at \$840.75 per day (average level used = PO2), for 1.5 days = \$1,261.12.

**In-kind contributions from University of Tasmania: Total = \$8,400**

- \$1400 per day for two people x 6 days = \$8,400.

**In-kind contributions from University of Adelaide: Total = \$7,000**

- One researcher for 10 days at a \$700 per day (based on level ACA 609) = \$7,000.

**Cash contributions from EPA: Up to \$5,000**

- To be negotiated in order to maximise the authority's benefits from the trip.

**In-kind contributions from EPA: Total = \$4,500**

- Video analysis of video drop surveys at 30 locations (3 sites x 10 replicates) within the Pearson Island Sanctuary Zone, based on 1-hr of analysis per site at a rate of \$100 per hour = \$3,000.
- Seagrass and water sample analysis at a rate of \$500 per site = \$1,500.

### 6.3.1. Technical Feasibility

See comments in section 5.2.1.

In addition there is a potential risk to the feasibility of the seagrass monitoring work because there is no specific allocation of time to carry this task out. It is estimated to take a total of 3-hrs and has been identified as a task that can be undertaken opportunistically to fit in around other work, as well as being something that can be undertaken in sheltered bays when poor weather prevents other work being undertaken. However, there is still a risk that this work may not be possible because of time constraints. If this work is not carried out then the cash contribution from the EPA towards the cost of the trip would be lost (as this is dependent on them achieving their monitoring).

The success of the BRUV surveys in the Marine National Park Zone is dependent upon the fabrication of appropriate frames for the mid-water BRUV set-up and the purchase of suitable lights for the benthic BRUV systems. In order ensure the feasibility of this work, it is recommended that expert advice be sought from researchers at Curtin University and the Australian Institute of Marine Science who have undertaken similar tasks successfully before.

### **6.3.2. Advantages**

Over and above the advantages of option 2 (set out in section 5.2.2), the major advantage of this option is the collection of inventory data on habitats and species from both benthic and mid-water areas within the Marine National Park Zone. There are currently no data available on the benthic habitats within the area, or the communities associated with them. This option will therefore provide completely new data on the communities and diversity found within the deeper waters of the Marine National Park Zone, which can be compared to the shallower areas nearby. In addition a greater proportion of the Sanctuary Zone can be swath-mapped on this longer trip, because it will be possible to collect an additional 3 nights' of data.

Value-added work by the EPA is also included in this option and involves important monitoring of the relatively pristine seagrasses in the Sanctuary Zone, which is used as a benchmark against which to compare the seagrass habitats in other areas.

This option has the added benefit to the State and Commonwealth marine parks programs of the inclusion of an additional member of eth science team who will be responsible for outreach and media activities such as blogging and vlogging (video-blogging). This will contribute to the public's overall value and understanding of the benefits of marine parks and the role of the marine park management teams.

### **6.3.3. Disadvantages**

This option is more expensive than option 2.

This option will achieve the minimum requirements for the State marine parks monitoring program, it does not allow any time for the systematic collection of video data on the presence and distribution of marine habitats and species within the Sanctuary Zone or the Marine National Park Zone. The amount of data that will be collected from the Marine National Park Zone is minimal because of the difficulty in covering a representative area of this extensive zone.

The constraints of the workload of DEWNR Marine Park Performance team staff mean that they cannot remain on-board the Ngerin after dive surveys have been completed and a second charter flight will be required to get these staff back to Adelaide. For the same reason, cost recovery must be found for the 2 DEWNR staff members on the BRUV team who will remain on-board after the monitoring work in the Sanctuary Zone is complete, so as to undertake the BRUV survey work in the Marine National Park Zone.

#### **6.3.4. Recommendation for option 3:**

This option is preferred over options 1 and 2 as it allows for the collection of some basic inventory data for benthic and pelagic habitats and species within the Commonwealth Marine National Park Zone and includes the value-added activity of seagrass monitoring by the EPA. There is an increased proportion of time spent on the science program (75 %) compared to the time (and cost) of travelling to the area (25 %). Consequently, the cost of getting the MRV Ngerin to the site makes up a reduced proportion of the total budget and time required to carry out this option, making this option more favourable.

## 6.4. Option 4.

### **Inventory habitat mapping and BRUV surveys within Pearson Island Sanctuary Zone and Western Eyre Marine National Park Zone.**

This option is based around a 14-day research expedition to the Pearson Island Sanctuary Zone and Western Eyre Marine National Park Zone on-board the MRV Ngerin, to take place during the period March-May 2018 (based on the best time of year for weather and sea conditions). This option involves 8 – 9 science staff. Not all staff will be on-board the vessel at the same time, so as to reduce redundancy and time requirements for the staff from each organisation:

- 3 staff from DEWNR Marine Park Performance Team, possibly including 1 regional management staff member (video drop, BRUV, geo-swath and drone operation capabilities). 2 staff will leave the expedition after approximately 5 days (once Sanctuary Zone and Marine National Park Zone BRUV monitoring is complete) and 1 will stay for the entire expedition (in-kind).
- 2 researchers from the University of Adelaide (connectivity study sampling, support with video drop and geo-swath surveys, blogging and outreach). To remain on the expedition for the full period.
- 1 or 2 staff from The Environment Protection Authority (seagrass and water chemistry sampling and analysis). If desirable, these people could join the trip part way through, when the DEWNR Marine Park Performance Team are leaving.
- 2 researchers from Flinders University (acoustic receiver deployment capabilities). If desirable, these researchers could leave the trip part way through with the DEWNR Marine Park Performance Team.

There is additional space on-board the research vessel, however this option currently only includes the minimum number of staff required to undertake the science plan outlined below. There is scope within this option for more science staff to join the expedition as long as funding could be secured to cover their travel and that their scientific aims could be achieved without impacting on the schedule of work set out in the expedition's science plan.

The 14-day time period includes travel for both the vessel and science staff from Adelaide to the Pearson Island area and back. A total of 11 days of science data collection are included (10 full days and 2 half days). This option does not include carrying out the core dive monitoring surveys within the Sanctuary Zone. Instead, the survey work proposed within the Sanctuary Zone focusses on inventory habitat mapping using video drops and also includes the core monitoring BRUV surveys. The rationale for this approach is to use the expedition as an opportunity to significantly increase the proportion of the Sanctuary Zone that is covered by a reliable habitat map. This will enable better understanding and quantification of the distribution and diversity of benthic habitats within the Pearson Island Sanctuary Zone. Inventory benthic habitat video mapping and BRUV surveys (benthic and mid-water) will also be carried out within the Marine National Park Zone.

This option also includes the deployment of 5 acoustic receivers in the waters off Pearson Island for monitoring marine animals tagged through other research programs within the region including white sharks, dusky sharks and bronze whalers. There are also plans to tag a number of other species over the coming year, which may also be picked up by this acoustic array, these are Australian salmon, King George whiting and school sharks. In addition, this option includes the collection of samples for connectivity studies from within both the Sanctuary Zone and the Marine National Park Zone, as well as seagrass monitoring in the Sanctuary Zone.

This option involves the vessel travelling separately from the 8-9 science staff. This saves on science staff time requirements as the vessel transit time is longer than travelling by plane from the Adelaide to Flinders Island, where there is a landing strip and mooring for the vessel. This option includes two return charter flights, in order for 2 staff from the DEWNR Marine Park Performance Team and 2 Flinders University researchers to leave the boat after their parts of the work has been completed (their work would be undertaken early on in the expedition). The second flight also means that there is an opportunity for other researchers to join the expedition part-way through (for example the EPA staff), should there be an interest in doing so. This would enable scientists to undertake a few days of work within the science program without needing to be on-board the vessel for the full duration of the trip.

Science program (broadly outlined in recommended order):

- Collection of seagrass, macroalgae and invertebrate fauna for connectivity studies, to be undertaken during dedicated dive surveys. This will secure samples from multiple trophic levels at a variety of depths from sites both inside and outside the Sanctuary Zone (3-4 dives). Total time to complete this work = 1 day.
- Collection of underwater video and still imagery during connectivity sample collection dives (no additional time required).
- Acoustic receiver station array deployment. The 5 receivers to be deployed are owned by DEWNR and managed by researchers at Flinders University. The stations each have a detection radius of approximately 500 m and will be deployed in a strategic array close to Pearson Island (exact location TBC). They will record the presence of any animals within the detection area that have been tagged with acoustic tags, including white sharks, dusky sharks and bronze whalers caught and tagged at the Neptune Islands, which are thought to use the waters around Pearson Island. This item requires a follow-up visit to the site in order to retrieve the receivers and download the data. The receivers could then either be re-deployed with new batteries (dependent on having secured funding for retrieval the following year) or could be removed completely from the Sanctuary Zone. This item requires 1-day of preparation before the trip (in-kind from Flinders University) and 1 day for deployment of the 5 stations by a team of 2 divers (in-kind from Flinders University). The deployment dives would be carried out on the same day as the connectivity sample collection dives above, so do not require any additional boat time.
- Collection of aerial video and still imagery of Pearson Island using a drone. To be undertaken by 1 member of the science team while dive/BRUV work is being undertaken close to the island (no additional time required).
- A member of the science team from the University of Adelaide will be responsible for writing daily blog posts about the expedition. These will include an update on the science

and monitoring work being undertaken each day as well as upload photos and video, if possible with the vessel's internet capabilities.

- DEWNR core monitoring benthic BRUV surveys at six sites (three inside and three outside the Sanctuary Zone), with four replicate drops at each site. Stereo BRUV systems will be used to survey species diversity and size (for biomass estimates). Each BRUV system will be deployed for one hour. This work requires a team of two from the DEWNR Marine Park Performance Team. Total time to complete this work = 3 days.
- Baseline data collection within the Marine National Park Zone using midwater and benthic BRUV drops. The zone covers an extremely large area, therefore it is not considered to be feasible to undertake a full, strategic sampling program within it. Midwater and benthic BRUVs will each be dropped at 3 sites within the Marine National Park Zone. Three replicates will be carried out at each site (total of 9 benthic BRUV and 9 midwater BRUV samples). The number of sites and replicates has been reduced compared to that achievable in option 3 (because of time constraints). The placement of sample sites can be undertaken randomly, or along a transect parallel to the boundary between the National Park and Sanctuary zone (length of boundary = 15.7 km, sites distributed at ca. 2.6 km intervals). There is scope for the sites to be located differently and/or for the benthic and midwater BRUV drops to both be undertaken at the same 3 sites. This work is to be undertaken by the DEWNR Marine Parks Performance BRUV team (2 staff), whose costs will need to be recovered for this task and who will leave the expedition after this task is complete. The total time required to complete this work = 2 days.
- Fish trapping for connectivity studies to be undertaken concurrently with BRUV deployments both inside and outside the Sanctuary Zone (at nearby sites, but far enough away not to affect BRUV survey) and in the evening/overnight at sites within the Marine National Park Zone. Requires a team of two and can be undertaken opportunistically to fit in around the other monitoring and inventory work. This work will secure samples from multiple trophic levels from benthic and mid-water habitats, both inside the Sanctuary Zone and the Marine National Park Zone, as well as within nearby unprotected waters. This work relies on fish traps being supplied on-board the MRV Ngerin.
- The DEWNR core monitoring inventory habitat mapping will be undertaken within the Sanctuary Zone using video drops across a sampling grid of 1 x 1 km, achieving coverage of one ca.50 m long drifted video transect survey per square km. An average of 5 x 50 m drifted video drops can be collected per hour (including transit between points). This work requires 1 member of DEWNR staff (in-kind, possibly from a regional management team), with the support of researchers from the University of Adelaide and EPA staff. Total time to complete this work across the entire Sanctuary Zone (135 sample sites) = 3.5 days.
- Inventory habitat mapping along two transects bisecting the Marine National Park Zone (one going south – north and one going east to west). A total of 60 video drop sites will be carried out along these transect lines, at approximate intervals of 1.25 km (depth dependent). An average of 5 x 50 m drifted video drops can be collected per hour (including transit between points). This work requires 1 member of DEWNR staff (in-kind, possibly from a regional management team), with the support of researchers from the University of Adelaide and EPA staff. Geo-swath instruments will be running whilst the

video transects are carried out. This will provide both geophysical and video habitat mapping data for the previously unmapped Marine National Park Zone. Total time to complete this work (60 sample sites with concurrent geo-swath mapping) = 1.5 days.

- EPA seagrass monitoring work, involving water and seagrass sampling and video drop surveys at 3 sites within the Sanctuary zone (at depths of less than 15 m); sample sites may include sites previously sampled in 2014. This systematic sampling procedure for surveying and assessing seagrass coverage and condition can easily be merged with the video drop inventory habitat mapping survey design above. Some extra time will be required to collect the additional video tows and water samples (in order to fit with standard EPA procedures). However the additional survey work only needs to be carried out at 3 sites and is estimated to take only ca. 1 hr per site. This work will involve 2 EPA staff with the support of 1 DEWNR staff and 2 University of Adelaide researchers. No additional time has been set aside to complete this work.
- For this option, the time spent undertaking swath surveys of the protected areas will be split across the State and Commonwealth zone, with the areas swathed in the Commonwealth zone focused around the sites of the benthic and pelagic BRUV surveys. There will be a total coverage of up to 60 km<sup>2</sup> (based on 5-6 km<sup>2</sup> per night x 10 nights), with half in each of the State and Commonwealth Zones. There is certainly scope for this allocation to be changed as long as the total coverage does not exceed 60 km<sup>2</sup>. No additional time is required for this work as it will be undertaken at night.

**Estimate of cash contributions required: TOTAL = \$97,153.15**

- MRV Ngerin for 15 days at an internal rate of \$3,600 per day (14 days at sea and 2 x 0.5 days for mobilisation and demobilisation) = \$54,400.
- Two return charter flights from Adelaide to Flinders Island for the science team (at a rate of \$6050 per return flight) = \$12,100.
- Satellite subscription for the 11 days of the expedition when survey work is being carried out (daily rate for this service of \$120) = \$1,320.
- Acoustic receiver deployment will involve the purchase of materials for creating moorings (ropes, shackles, floats etc.) and for securing the receivers to the seafloor (with star pickets), estimated at \$300 per receiver. In addition, the cost of renting a vessel to retrieve the receivers within 1-year from deployment must also be included, so as to ensure the data from the receiver array can be retrieved = \$1,500 from Elliston (1-day trip). Total cost for this item = \$3,000.
- 20 full compressed air tanks for the dive work (connectivity studies and deploying acoustic receivers) at a rate of \$10 per tank = \$200.
- Rental of a HD camera system with depth range of up to 100 m. This will be used to undertake the video drop survey across the Sanctuary Zone. This is required because the cable length of the DEWNR video system limits its use to shallower waters. The total cost of this system (based on a 14-day rental period, including freight from Perth) = \$4,730.
- Cost of the DEWNR benthic BRUV systems for 2-days to carry out surveys in the Marine National Park Zone (8 units charged at a rate of \$75.per unit) = \$1,200.
- Cost of 2 DEWNR staff to undertake benthic and mid-water BRUV sampling in the Marine National Park Zone (2-days). Because of logistical constraints, these staff also need to be on-board the vessel on the first day of the expedition whilst acoustic receiver deployment



and connectivity sample collection is undertaken. Staff time is charged at a PO2 level rate of \$840.75 for 3 days = \$5,044.50.

- Fabrication of galvanised steel frames for creating mid-water BRUV systems to be used to survey with the Marine National Park Zone. The DEWNR BRUV frames are designed for benthic sampling and cannot be used for mid-water surveys. Cameras can be loaned, either from University of Adelaide researchers, or from the DEWNR benthic BRUV systems and are depth rated to 150 m. Total cost of fabrication of 4 mid-water BRUV frames (including camera mounts) at \$814 per unit (including GST) = \$3,256.
- Cost of purchasing longer ropes and lights for the DEWNR benthic BRUV systems, so that they can be used in the deeper water of the Marine National Park Zone (average depth is > 80m). Light systems (LED, wide beam, with red-light options and mount) will cost approximately = \$1000 per BRUV unit. Ropes will cost approximately \$200 per BRUV unit (150 m). To reduce the cost of these items, the number of benthic BRUV units used for the deeper-water work will be reduced from 8 to 4. Parts of the other 4 DEWNR BRUV systems on-board the vessel can be used to support the midwater BRUV work (e.g. cameras, ropes, floats etc.). Total cost of this item = \$4,800.
- Cost of DEWNR Marine Parks Performance Team staff time for data-processing of BRUV survey data from the Marine National Park Zone, based on ca. 2-hrs of analysis per BRUV drop (18 BRUV drops x 2hrs = 36hrs). Staff costed at \$840.75 per day (average level used: PO2), for 5 days = \$4,203.75.
- Cost of DEWNR Marine Parks Performance Team staff time for data processing of inventory habitat mapping data from 60 sites within the Marine National Park Zone, based on ca. 50 video drop sites per day (average level used = PO2) = \$1,008.90.
- Purchase of a remote piloted aircraft (drone) for the collection of high-resolution aerial imagery of the Pearson Island Sanctuary Zone during the expedition. The aim is to achieve a record of the expedition and collect inspiring footage that clearly demonstrates the value of the Sanctuary Zone. This footage will be used to contribute to the State marine parks program objectives of increasing public appreciation of marine parks, supporting education, increasing positive media and an improved community understanding of sanctuary zones and their habitats. It is more cost-effective to purchase these items than to rent them as rental requires the mandatory hire of a drone-operator including their travel and accommodation costs. The estimated total cost for this item is \$1,890 (see itemisation below):
  - o Purchase of 3DR Solo quadcopter = \$1400.
  - o Purchase of a spare battery = \$220.
  - o Purchase of 2 sets of propellers = \$50.
  - o Purchase of carry case = \$220.
  - o DEWNR has existing GoPro camera equipment that can be attached to an in-built 3-axis gimbal mount on the Solo 3DR quadcopter.
  - o Free mission planning software is available.
  - o Members of the science team have adequate experience piloting drones in order to collect the required footage.

**In-kind contributions from DEWNR: Total = \$87,607.75**

- Staff salary for 20 days of preparation and planning in the run-up to the expedition (trip planning, logistics, equipment preparation, instrument calibration before and after trip, OH&S, organising permitting, preparing on-board the vessel and demobilisation). Staff costed at \$840.75 per day (average level used: P02) = \$16,815.
- Staff costs for science team during the expedition: 2 staff members x 4 days (1 travel day and 3 days on-board vessel undertaking BRUV core monitoring surveys) and 1 staff member for 12 days (1 travel day and 11 days on-board vessel undertaking BRUV core monitoring surveys, video drop surveys and providing general science support). Staff costed at \$840.75 per day (average level used: P02) = \$16,815.
- BRUV equipment (8 x stereo BRUVS) at \$75 per unit per day for 3 days of surveys in the Sanctuary Zone and another 9 days that the gear will be on-board the MRV Ngerin but not being used (including transit days) = \$6,600.
- Geo-swath instrumentation at \$1000 per day for the 14 days that the gear will be on the boat (including transit days) = \$14,000
- Data-processing for BRUV surveys from within the Pearson Island Sanctuary Zone, based on ca. 2-hrs of analysis per BRUV drop (24 BRUV drops x 2hrs = 48hrs). Staff costed at \$840.75 per day (average level used: P02), for 7 days = \$5885.25.
- Data processing for geo-swath data based on 0.5 days per km<sup>2</sup> of data collected. Staff costed at \$840.75 per day (average level used: P02), for 30 days = \$25,222.5.
- Data processing for video drop data collected from 135 sample locations within the Pearson Island Sanctuary Zone, based on processing of 50-drops per day, so a total processing time of 2.7 days. Staff costed at \$840.75 per day (average level used: P02) = \$2,270.

**In-kind contributions from University of Adelaide: Total = \$14,400**

- 1 researcher at \$700 per day (based on level ACA 609) for 12 days (including travel time) = \$8,400.
- 1 technician at \$500 per day (based on level HEO 5) for 12 days (including travel time) = \$6,000.

**In-kind contributions from Flinders University: Total = \$6,000**

- 1 researcher at \$700 per day (based on level ACA 609) for 5 days (including travel time) = \$3,500.
- 1 technician at \$500 per day (based on level HEO 5) for 5 days (including travel time) = \$2,500.

**Cash contributions from EPA:**

- \$5,000 based on maximising the authority's benefits from the trip.

**In-kind contributions from EPA: Total = \$4,500**

- Video analysis of video drop surveys at 30 locations (3 sites x 10 replicates) within the Pearson Island Sanctuary Zone, based on 1-hr of analysis per site at a rate of \$100 per hour = \$3,000.
- Seagrass and water sample analysis at a rate of \$500 per site = \$1,500.

### **6.4.1. Technical Feasibility**

This option is technically feasible. The MRV Ngerin is well-suited to this type of work and has the appropriate equipment on board (e.g. fish traps, compressor). The science teams and equipment are capable of the tasks required in order to successfully achieve the science program outlined above. However, the success of the BRUV surveys in the Marine National Park Zone is dependent upon the fabrication of appropriate frames for the mid-water BRUV set-up and the purchase of suitable lights for the benthic BRUV systems. In order ensure the feasibility of this work, it is recommended that expert advice be sought from researchers at Curtin University and the Australian Institute of Marine Science who have undertaken similar tasks successfully before.

There is some risk as to whether the amount of work scheduled can be carried out within the allocated timeframe. This is because no time has been allowed for weather interruptions. There is no possibility of building in additional time to allow for interruptions to the program due to inclement weather, because the MRV Ngerin is limited to a maximum of 14-days at sea before re-supply is needed.

Overall the technical feasibility is considered improved compared to option 3 because there is a dedicated time allowance for the collection of samples for connectivity studies (rather than these tasks needing to be completed opportunistically around the other work).

### **6.4.2. Advantages**

A greater variety of data will be collected from the Marine National Park Zone, with geo-swath and video inventory habitat mapping being added in this option, in addition to the mid-water and benthic BRUV surveys included in option 3. This will enhance the suite of data available to create a baseline for this zone. A further advantage of this option is the addition of the deployment of an array of acoustic receivers close to Pearson Island for the monitoring of acoustic-tagged marine megafauna using the area. Tagged species within the region include white sharks, dusky sharks and bronze whalers and will soon also include Australian salmon, King George whiting and school sharks. These data will also contribute to the wider Integrated Marine Observing System database and will likely be representative of the species using the wider area, including the waters of the adjacent Marine National Park Zone.

The main advantage of this option is the near-complete coverage of the Sanctuary Zone by video drop inventory habitat mapping. This work takes considerable time and it is extremely unlikely that it would be achievable during a monitoring trip undertaken by DEWNR as part of their core monitoring work, due to time and funding constraints. These data, will enable a broad-scale habitat map to be compiled across the Sanctuary Zone. In areas where video and geo-swath data have been collected in both the Sanctuary Zone and the Marine National Park, a more detailed analysis of the habitats present can be achieved.

### **6.4.3. Disadvantages**

This option is more expensive than options 1, 2 and 3.

Work load constraints upon the DEWNR Marine Park Performance Team mean that they cannot remain on-board the Ngerin after the BRUV surveys have been completed and a second charter flight will be required to get these staff back to Adelaide. For the same reason, cost recovery must be found for the 2 DEWNR staff members on the BRUV team who will remain on-board for an additional 2 days after the monitoring work in the Sanctuary Zone is complete (so as to undertake the BRUV survey work in the Marine National Park Zone).

No dive surveys within the Sanctuary Zone are included in this option due to time constraints. It was decided that the dive work would be dropped and the BRUV work retained (each takes 3 days) because some dive survey data already exists for this zone (macroalgae, seagrass, habitats sessile invertebrates and reef fish), but there are no BRUV surveys. The BRUV data can provide an indication of both the species diversity and biomass of fish in the area, which would be new information for this Sanctuary Zone.

This option includes a reduced BRUV survey effort in the Marine National Park Zone compared to option 3 (6 sites instead of 8, with a total of 36 BRUV samples instead of 48). This was done on the basis of time constraints, however a reasonable number of samples will still be achieved and the addition of video inventory of habitats is considered to be a beneficial trade off.

#### **6.4.4. Recommendation for option 4:**

This option is preferred over options 1, 2 and as it allows for the collection of detailed habitat mapping inventory data across the almost the entire area of Pearson Island Sanctuary Zone and across two transects bisecting the area of the Marine National Park Zone. It also will provide data on the presence of tagged fish species around Pearson Island, contributing key information about key predatory and iconic species using the area. The connectivity sampling, seagrass monitoring, and BRUV surveys that are listed as part of option 2 will also be carried out. Overall there is an increased diversity of data being collected and an increased proportion of time spent on the science program (80 %) compared to the time (and cost) of travelling to the area (20 %). Consequently, the cost of getting the MRV Ngerin to the site makes up a reduced proportion of the total budget and time required to carry out this option, making this option more favourable.

## 6.5. Option 5.

### **Inventory habitat mapping and core monitoring surveys (diving and BRUV) within Pearson Island Sanctuary Zone with inventory habitat mapping, BRUV baseline monitoring and geo-swath surveys in the Western Eyre Marine National Park Zone.**

This option is based around the same 14-day trip on Ngerin as described in option 4, with an additional 5-day boat trip on a charter boat from Port Lincoln in order to carry out the DEWNR Marine Park Performance Program core monitoring dive surveys in the Sanctuary Zone. This will require an additional 6 members of the science team who will be on-board the charter vessel:

- 4 staff from DEWNR Marine Park Performance Team (dive team).
- 2 researchers from the University of Tasmania (dive support).

There is likely to be additional space on-board both the research vessel and the charter boat, however this option currently only includes the minimum number of staff required to undertake the science plan. There is scope within this option for more science staff to join the expedition as long as funding can be secured to cover their travel and that their scientific aims can be achieved without impacting on the schedule of work set out in the expedition's science plan.

The additional 5 days on-board the charter vessel includes travel from Port Lincoln to the Pearson Island Sanctuary Zone and back (with science staff on board). A total of 3 days of science data collection are included in order to carry out 3-days of dive surveys which would allow the completion of the full suite of core monitoring within the Pearson Island Sanctuary Zone (dive transect surveys, benthic BRUV surveys and inventory habitat mapping with video drops with 1 x 1 km coverage).

#### **Science program:**

- All items outlined as in option 4 (to be carried out from MRV Ngerin).
- DEWNR Marine Parks Performance Program core monitoring dive surveys. Diving will be carried out directly from the charter boat. Divers will undertake line transect surveys with recording of fish species and abundance (200 x 10 m strip), invertebrate species and abundance (200 x 2 m strip) and information on habitat type and macroalgae (80 photo quadrats). Dive surveys will be undertaken at eight dive sites (four inside and four outside the Sanctuary Zone). This work requires a team of 6 (4 DEWNR staff and 2 University of Tasmania staff). Total time required to complete this work = 3 days.

#### **Estimate of cash contributions required: TOTAL = \$133,277.15**

- Total as for option 4 = \$97,153.15
- Cost of charter boat from Port Lincoln for 5 days (including berths, food and drinks, fuel and crew) = \$35,000.
- Cost of travel from Adelaide to Port Lincoln for team of 6 divers in 2 cars, based on ca. \$100 per car = \$200.
- Cost of food allowance for 4 DEWNR staff during day of travel at rate of \$77 per day for 2 days (one day of travel in each direction Adelaide – Port Lincoln – Adelaide) = \$924.

#### **In-kind contributions (all organisations): Total = \$122,669.5**

- Total as for option 4 = \$87,607.75.

- DEWNR: Additional 4 staff for dive team for 7 days (5-days on-board the charter vessel and 2 days for travel Adelaide - Port Lincoln - Adelaide), costed at \$840.75 per day (average PO2 level) = \$23,541.
- DEWNR: Staff dive allowance costs of \$40 per day for 4 staff for 3 days = \$480.
- DEWNR: Data validation and processing for dive survey data based on ca. 1-hr per dive. Staff costed at \$840.75 per day (average PO2 level used) for 1 day = \$840.75.
- DEWNR: 40 full compressed air tanks for diving at \$10 per tank = \$400.
- University of Tasmania: \$1400 per day for two people x 7 days = \$9,800.

### **6.5.1. Technical Feasibility**

See comments in section 5.4.1. as for option 4.

Whilst it is feasible for both vessels to be undertaking survey work in the area at the same time, some consideration must be given to the work that is carried out concurrently. It is essential that dive surveys from the charter vessel be undertaken during the latter part of the Ngerin science program, so that they do not coincide with times when BRUVs are being used from the MRV Ngerin (because of the potential for sharks to be attracted into the area by the bait).

In addition, the divers' air tanks would need to be transported aboard the Ngerin and then transferred to the charter vessel from which the dive work is to take place. This is because it is not feasible for 40 compressed air tanks to be transported from Adelaide to Port Lincoln where the charter vessel will be leaving from. It may be possible to rent filled tanks in Port Lincoln, but this is likely to be a more expensive option.

### **6.5.2. Advantages**

In addition to those listed as for option 4 in section 5.4.2. Option 5 is the most detailed science program and achieves all of the DEWNR core monitoring required for the Pearson Island Sanctuary Zone, whilst also collecting valuable baseline and inventory survey data from the Marine National Park Zone.

### **6.5.3. Disadvantages**

This option is more expensive than options 1, 2, 3 and 4. The additional expense is large because of the requirement of a second vessel in order to undertake the dive surveys. The day rate of the charter vessel is considerably higher than that of the Ngerin however it is not possible to add extra days on the schedule for the Ngerin as it cannot undertake trips of more than 14-days duration.

The constraints of the workload of the DEWNR Marine Park Performance Team mean that they cannot remain on-board the MRV Ngerin after the BRUV surveys have been completed and a second charter flight will be required to get these staff back to Adelaide. For the same reason, cost recovery must be found for the 2 DEWNR staff members on the BRUV team who will remain on-board MRV Ngerin for an additional 2 days after the monitoring work in the Sanctuary Zone is complete, so as to undertake the BRUV survey work in the Marine National Park Zone.

This option includes a reduced BRUV survey effort in the Marine National Park Zone compared to option 2 (6 sites instead of 8, with a total of 36 BRUV samples instead of 48). This was done on the basis of time constraints, however a reasonable number of samples will still be achieved.

#### **6.5.4. Recommendation for option 5:**

This option allows for the collection of detailed habitat mapping inventory data across the entire Pearson Island Sanctuary Zone, as well completing all core monitoring with this priority Sanctuary Zone and collecting data on benthic and pelagic habitats and species within the Commonwealth Marine National Park Zone. This option is preferred over options 1, 2 and 3, although not option 4 because the additional benefits of option 5 are not considered valuable enough to warrant the additional costs.

#### **6.6. Additional costs**

Each of the options outlined includes the cost of getting out to site and collecting a range of data, and where appropriate also undertaking processing of these data into a useable format. However, in order to make use of the wealth of data collected in a trip such as this, a considerable amount of time needs to be spent on data collation, analysis and synthesis after returning from the expedition. The cost of this work has not been included in the options outlined.

It is estimated that it would take between 4 and 6 months to produce a report from the expedition which adequately contextualises and synthesises the data collected in a way that is useful for the State and National marine park programs. This report would also support the development of the public release of outcomes from the trip. The total, additional cost of this work is estimated at between \$58,000 to \$87,000 (depending on the trip duration and time required for analysis and reporting). This is based on the work being carried out by an experienced research associated (pay level ACA 609).

## 7. Comparison of options and recommendation

Table 2 contains a summary of the main activities covered in the various options described in section 5 and which of the options includes each activity. The trend is for a greater amount of survey work to be undertaken for a greater cost. Option 5 is the most complete and achieves all of the monitoring and survey activities, however it is more than three times the cost of option 2, which still achieves all of the core monitoring within the Sanctuary Zone, but none of the baseline work in the Marine National Park Zone.

**Table 2:** Summary and comparison of the five options for the expedition as outlined in section 5. PISZ = Pearson Island Sanctuary Zone. WEMNP = Western Eyre Marine National Park Zone. Green fill indicates that an activity is included in an option and grey fill indicates that it is not. (\* included in SA marine park reporting).

Activity	Option 1	Option 2	Option 3	Option 4	Option 5
	<i>Do Nothing</i>	<i>Dive &amp; BRUV surveys PISZ only</i>	<i>Dive &amp; BRUV surveys PISZ &amp; BRUV WEMNP</i>	<i>BRUV &amp; video inventory surveys PISZ &amp; WEMNP</i>	<i>Dive &amp; BRUV &amp; video inventory habitat surveys PISZ &amp; BRUV &amp; inventory habitat surveys WEMNP</i>
DEWNR core monitoring in PISZ - dive surveys: 3 days					
DEWNR core monitoring in PISZ - BRUV surveys: 3 days					
DEWNR video inventory habitat mapping in PISZ: 3.5 days					
DEWNR video inventory habitat mapping in WEMNP: 1.5 days					
Fish collections in PISZ & WEMNP (connectivity): opportunistic					
Benthic species collection in PISZ (connectivity): opportunistic					
Benthic species collection in PISZ (connectivity): strategic					
Swath mapping during the evening/at night in PISZ		30-36 km <sup>2</sup>	45-54 km <sup>2</sup>	30 km <sup>2</sup>	30 km <sup>2</sup>
Swath mapping during the evening/at night in WEMNP				30 km <sup>2</sup>	30 km <sup>2</sup>
Acoustic receiver deployment in PISZ: 1 day					
Seagrass monitoring in PISZ (EPA): opportunistic					
BRUV surveys in WEMNP (mid-water & benthic): 2 days					
Aerial imagery from drone in PISZ (media): opportunistic					
Underwater imagery in PISZ (media): opportunistic					
On-board expedition blog and public outreach activities					
<b>Total cost of expedition</b>	<b>\$0</b>	<b>\$45,660</b>	<b>\$83,666</b>	<b>\$97,153</b>	<b>\$133,277</b>
<b>Additional:</b> Analysis, integration and publication of collected data		*	<b>\$58,000</b>	<b>\$87,000</b>	<b>\$87,000</b>



## 7.1. Recommended Option

Based on the comparison of options, Option 4 is recommended, along with additional funds for analysis, integration and publication of data (see details in section 5.6). This choice has been made on the basis of cost-benefits and the significant gains that Option 4 offers to both the State and Commonwealth marine protected area programs in terms of baseline and inventory data collection and monitoring outcomes. Option 4 accomplishes the majority of the standard core monitoring required for the Sanctuary Zone, including BRUV surveys and inventory habitat mapping. Significant value-added items such as geo-swath coverage and seagrass condition surveys, will also contribute to the assessments of the distribution and status of marine habitats within the States Sanctuary Zone. In addition, new information on the habitats and biodiversity of the Marine National Park Zone will be generated. The cost of expedition outlined in Option 4 is \$97,153.15 and the cost of collation, analysis, integration and publication of the outcomes is an additional \$87,000.

It should be noted that Option 4 does not include dive line transect surveys of reef habitats, fish and invertebrates in the Sanctuary Zone. This is considered an acceptable trade-off because Reef Life Survey dive transects were undertaken at multiple sites both inside and outside the Sanctuary Zone in 2014. These data can potentially be used to assess the health and diversity of the reef systems within the zone. The addition of dive surveys to the science program for the expedition (as outlined in option 5) involves extra costs of over \$35,000, and this is not seen to represent a good cost-benefit to the Marine Parks Program. There is no difference between options 4 and 5 in the quantum of data collected from within the Commonwealth's Western Eyre National Marine Reserve. Thus there is little direct benefit to information gained about the Marine National Park Zone by undertaking the more expensive Option 5, which will not already be gained from the adjacency to the State Sanctuary Zone.

Currently there is almost nothing known about the habitats, flora and fauna found with the Western Eyre Marine National Park. The attainment of inventory habitat mapping, geo-swath data (sediment type and seafloor features) and BRUV surveys of benthic and mid-water fish and other fauna (as proposed in Option 4) will be a huge addition to the knowledge about this Marine National Park Zone. These data will directly contribute to the establishment of baseline data for the Marine National Park Zone and will help to determine management priorities and performance outcomes for the Sanctuary Zone.

One of the key protection-based outcomes of the State and National marine park networks is the enhancement of ecosystem status, function, connectivity and resilience through increasing or maintaining recruitment. This achievement of this is dependent on the protected areas within the networks acting as sources of recruitment and biodiversity for the broader marine environment and on connectivity between the protected areas forming the networks. Assessing the effectiveness of the marine park networks for delivering this outcome will require a better understanding of the connectivity between the South Australian Representative System of Marine Protected Areas, the broader National Representative System of Marine Protected Areas and the surrounding unprotected waters. The connectivity data collected from both the National Marine Park Zone and the Sanctuary Zone will improve the understanding of movements between and / or isolation of these two areas, as well as their context within the broader State and National Marine Reserve Networks.

The acoustic receiver array will be located close to Pearson Island, within the Sanctuary Zone (for reasons of logistics and diver access in these shallower waters). However, there will be benefits of this array to both the State and Commonwealth programs. The array will provide information on the use of the area by both local and migratory marine megafauna species. Detection of these wide-ranging animals (e.g. white sharks, dusky sharks bronze whalers) will contribute to understanding their use of the wider area of both the Sanctuary Zone and the Marine National Park Zone.

Option 4 also achieves added-value through the collection of seagrass habitat status assessment data in partnership with the Environment Protection Authority, as well as the aerial and underwater footage from within the Sanctuary Zone, and video-drop and BRUV monitoring footage from the Marine National Park Zone. Additionally, expedition blogging, vlogging (video blogging) and social media activities will help both the State and Commonwealth with their education, outreach and community engagement programs.

This option makes the most of collecting ongoing monitoring information for the South Australian Marine Parks Program with the additional expenditure for expanded surveys into the Marine National Park being relatively cost effective. The expansion of sampling to include the larger area within the Commonwealth Western Eyre National Marine National Park and additional data sets are the most significant benefits gained from choosing this option.

## 8. Consultation list and expedition partners

### 8.1. Partner organisations

Partner organisation	Role	Responsibilities
DEWNR Marine Parks Performance Team	Overall organisation	Trip planning, preparation and permitting. Logistics and budgeting. Overall trip organisation as well as undertaking much of the survey work on-board the vessel, including collection of drone footage.
University of Tasmania	Dive support	Part of the dive team undertaking core monitoring surveys within the Sanctuary Zone.
University of Adelaide	Connectivity studies and on-board media	Planning, collection and analysis of connectivity samples from the benthos (primary producers, grazers and predators) as well as fish trapping. Responsibility for public outreach and education materials being collected and broadcast during the expedition (blogging, vlogging, tweeting etc.).
EPA	Seagrass monitoring	Undertaking seagrass condition surveys, sample collections and water samples from 3 sites (10 replicates at each site) according to standard EPA protocol.
Flinders University	Acoustic receiver array	Preparation and deployment of moorings and acoustic receiving stations (x5) in an array close to Pearson Island. Coordination of boat trip for receiver retrieval within 1-year of deployment.

## 8.2. Consultation list.

Below is a list of the people consulted during the preparation of this report:

<b>Name</b>	<b>Organisation</b>
Michelle Waycott	DEWNR/University of Adelaide
Alison Wright	DEWNR
Simon Bryars	DEWNR
Danny Brock	DEWNR
David Miller	DEWNR
Robyn Morcom	DEWNR
Dimitri Colella	DEWNR
Annelise Wiebkin	DEWNR
Angus Mitchell	DEWNR
Charlie Huveneers	Flinders University
Paul Rogers	SARDI Aquatic Sciences
Simon Goldsworthy	SARDI Aquatic Sciences
Alice Mackay	SARDI Aquatic Sciences
Fred Bailleul	SARDI Aquatic Sciences
Matthew McMillan	University of Adelaide
Bronwyn Gillanders	University of Adelaide
Steve Donnellan	South Australian Museum
Jason Castro	DJ Steel Fabrication
Francine Watts	UVS / Bluezone Group
Euan Harvey	Curtin University
Graham Edgar	University of Tasmania
Mitch Waring	Altitude Aviation
Sam Gaylard	Environment Protection Authority
James Seager	SeaGIS Pty Ltd
Simone Cohen	Australasian Marine Associates
General enquiry	Rossair Charter
David Clayfield	Why Not Fishing Charters

## 9. Addendums

---

During the process of researching and preparing this report, some important issues became apparent that are worth noting at this point.

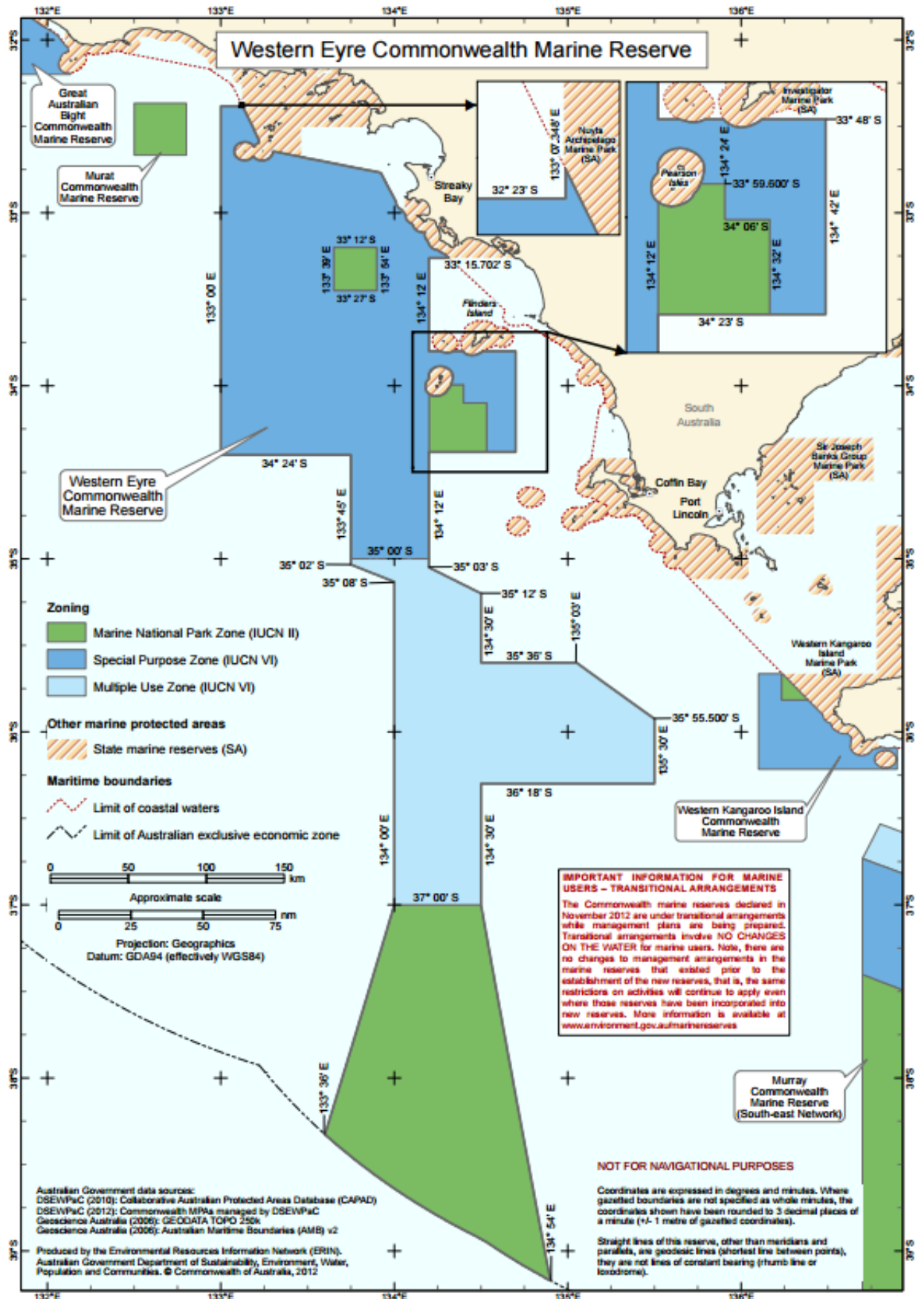
### **9.1. Potential to extend the expedition and carry out monitoring at additional State Sanctuary Zones.**

The State has a number of other offshore island Sanctuary Zones within the south-west region. It was suggested that there is an opportunity to combine the proposed expedition to the Pearson Islands Sanctuary Zone and Western Eyre Marine National Park with a trip further west to the Topgallant and/or Nuyts Archipelago Sanctuary Zones. This would require a vessel re-supply stop at Ceduna (or similar), but overall it represents a good value-for-money option, as the vessel would have undertaken a considerable part of the journey to these island by the time it reached Pearson Island Sanctuary Zone. If funding is found for one of the options proposed in this report, it is recommended that a 'piggy-back' trip to the Sanctuary Zones further west is seriously considered. It is likely that there would be a significant cash contribution from DEWNR for such a trip.

### **9.2. Interest in undertaking terrestrial surveys on Pearson Island.**

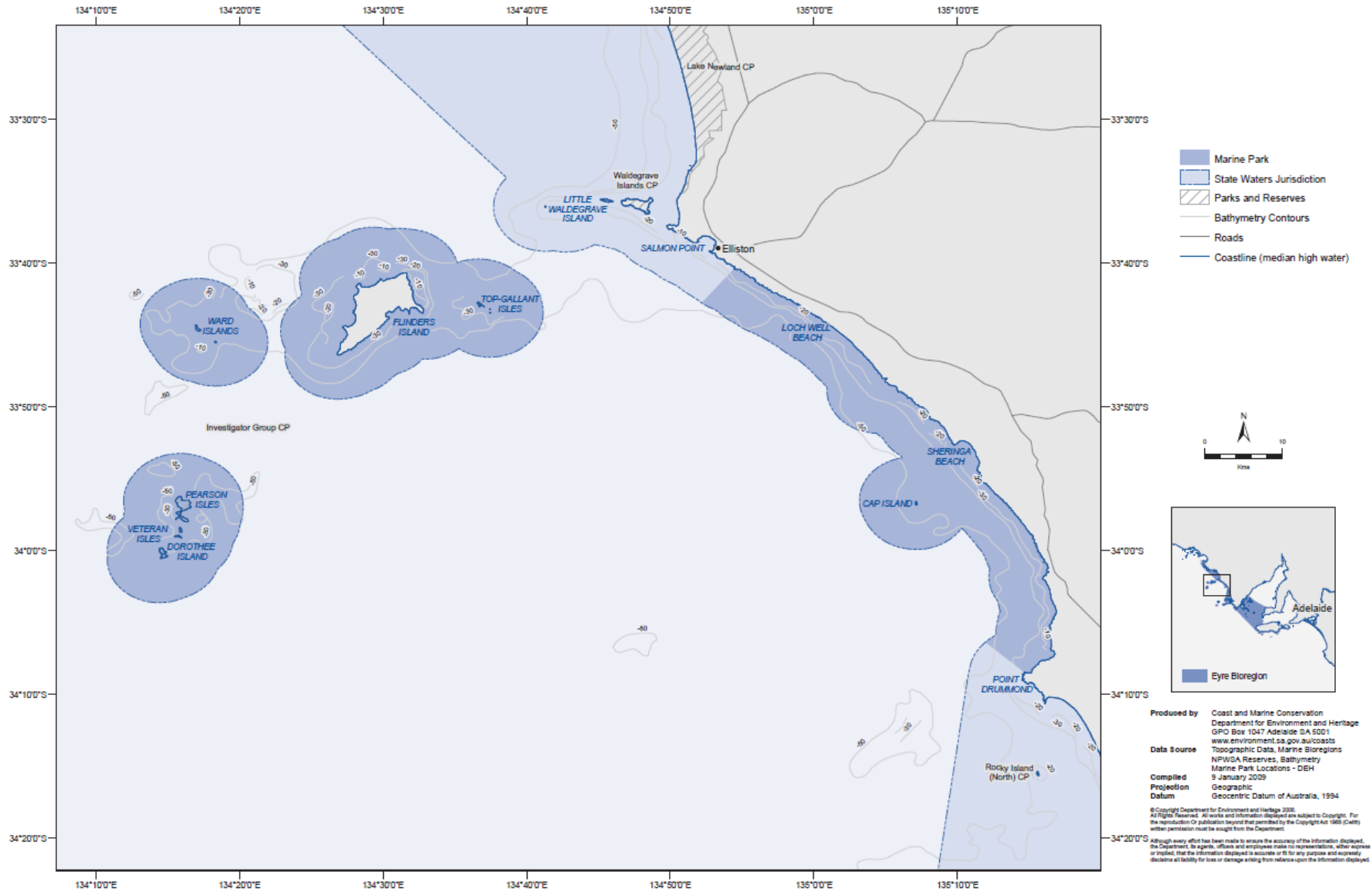
Tentative interests have been expressed in visiting the Pearson Islands themselves to carry out vegetation surveys and research on the endemic Pearson Island Rock Wallaby. There are photo points on the island that have been established since the 1920s and visited at several points since, the last time being during the 2006 expedition with the Royal Society of South Australia. The island is recognised for its near-pristine examples of pre-European settlement terrestrial habitats, including a lack of introduced weed species and there would almost certainly be interest from terrestrial biologists in an opportunity to visit and collect survey data.

### 9.3. Detailed map of Western Eyre Commonwealth Marine Reserve.



### 9.4. Detailed map of Investigator Marine Park

#### Investigator Marine Park



## 10. References

---

- Baker, J. L., S. A. Shepherd, D. Turner and K. Edyvane (2008). "Investigator Group Expedition 2006: Benthic Macroalgal Studies at Islands in the Eastern Great Australian Bight Over Three Decades." Transactions of the Royal Society of South Australia **132**(2): 251-267.
- Bryars, S. (2003). An inventory of important coastal fisheries habitats in South Australia. Adelaide, Primary Industries and Resources SA (PIRSA).
- Bryars, S., J. Brook, C. Meakin, C. McSkimming, Y. Eglinton, R. Morcom, A. Wright and B. Page (2016). Baseline and predicted changes for the Investigator Marine Park (draft report). Department of Environment, Water and Natural Resources, South Australia.
- Bryars, S. and R. Wear (2008). "Investigator Group Expedition 2006: Seagrasses of the Investigator Groupregion: Posidonia Meadow Condition in a pristine Offshore Marine Environment." Transactions of the Royal Society of South Australia **132**(2): 81 - 94.
- Collings, G., S. Bryars, D. Turner and M. Theil (2008). Examining the health of subtidal reef environments in South Australia, Part 4: Assessment of community reef monitoring and status of selected South Australian reefs based on the results of the 2007 surveys. Adelaide, SARDI Aquatic Sciences.
- Director of National Parks (2013). Draft South-west Commonwealth Marine Reserves Network Management Plan 2014-24. Canberra., Australian Government - Director of National Parks.
- Edyvane, K. S. ( 1999). Conserving Marine Biodiversity in South Australia, Part 2: Identification of areas of high conservation value in South Australia. SARDI Aquatic Sciences, Adelaide.
- Gaylard, S., M. Nelson and W. Noble (2013). The South Australian monitoring, evaluation and reporting program for aquatic ecosystems: Rationale and methods for the assessment of nearshore marine waters. Adelaide, Environment Protection Authority.
- Goldsworthy, S. and B. Page (2009). A review of the distribution of Seals in South Australia. Adelaide, South Australian Research and Development Institute (Aquatic Sciences): 21.
- Goldsworthy, S. and B. Page (2010). Review of the distribution of crested terns, little penguins, short-tailed shearwaters and flesh-footed shearwaters in the South-west Marine Region off South Australia. Adelaide, South Australian Research and Development Institute (Aquatic Sciences): 13.
- Miller, D. J. and A. Wright (2008). "Investigator Group Expedition 2006: Application Of Remote Survey Techniques to Characterise the Benthic Habitats." Transactions of the Royal Society of South Australia **132**(2): 243-250.
- Shepherd, S. A. and H. B. S. Womersley (1971). Pearson Island expedition 1969 – 7. The sub-tidal ecology of benthic algae. T. o. t. R. S. o. S. Australia. 95, 155–167.
- Sorokin, S., T. C. D. Laperousaz and G. J. Collings (2008). "Investigator Group Expedition 2006: Sponges (Porifera)." Transactions of the Royal Society of South Australia **132**(2): 163-172.
- Wiebkin, A. S. (2012). Feeding and breeding ecology of little penguins (*Eudyptula minor*) in the Eastern Great Australian Bight. Doctor of Philosophy, University of Adelaide.