South Australian collaborative monitoring and research expedition 2018

Western Eyre and Investigator Marine Parks

Australian Government
Parks Australia

Australian Marine Parks

Government of South Australia

THE UNIVERSITY of ADELAIDE

Flinders UNIVERSITY

National Parks and Wildlife Service SOUTH AUSTRALIA

Research vessel Ngerin off the coast of Pearson Island
Cover: Australian sea lion at Pearson Island

Contents

South Australian Collaborative Research Expedition

This report describes the research and monitoring undertaken on a 12-day collaborative expedition to discover more about Australia's network of marine parks.

The aim was to deliver a successful collaborative research expedition in partnership with the Australian Government (Parks Australia), South Australian Research and Development Institute (SARDI) Aquatic Sciences, Environment Protection Authority (EPA), University of Adelaide, Flinders University and the Integrated Marine Observing System (IMOS).

The expedition, led by South Australia's Department for Environment and Water (DEW), consisted of a multi-disciplinary research team aboard the Research Vessel Ngerin to gather baseline ecological data and undertake critical monitoring work within the Australian Western Eyre and South Australian Investigator marine parks.

The 12-day expedition successfully undertook activities to map the seafloor, capture video of fish biodiversity, deploy acoustic receivers to track large predators, collect fish, invertebrate and sediment samples, and test for micro-plastic contamination.

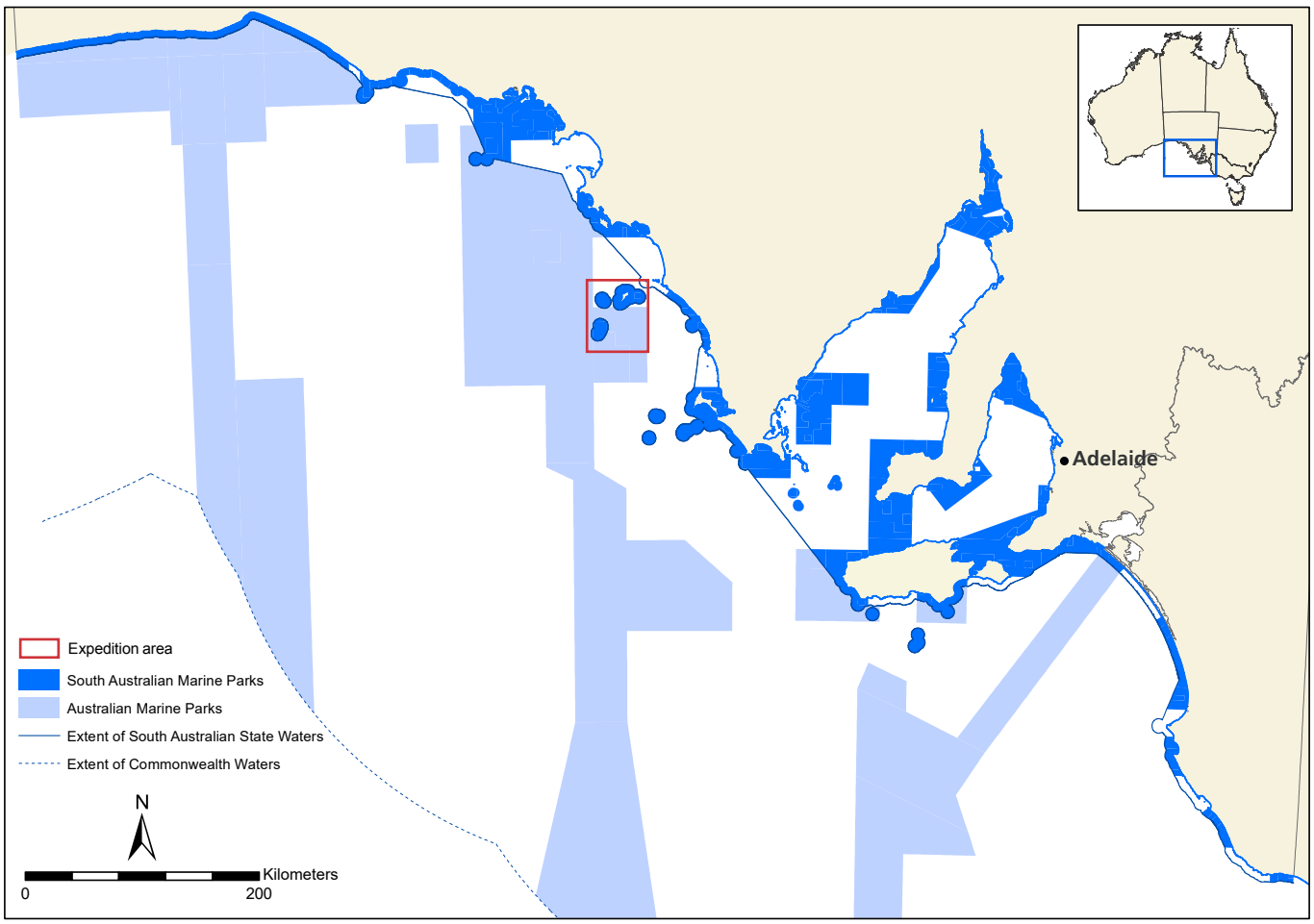
Rationale

In Australia, marine parks are designed to protect biodiversity and contribute to the long-term viability of the marine environment, while enabling opportunities for sustainable development and recreational use of these special places.

The waters off South Australia contain marine parks that are managed by both the South Australian Government (within state waters) and the Australian Government (within Commonwealth Waters, see map below). When designing marine parks, a complementary approach to the location of marine parks was taken so that in many instances, boundaries align across state and Commonwealth Waters. This establishes a good foundation for collaboration in marine park management while improving conservation outcomes.

The Investigator and Western Eyre Marine Parks collaborative expedition was instigated to meet the monitoring, evaluation and reporting requirements of both jurisdictions. Periodic data collection from priority marine parks will ensure that the ecology of the parks is better understood, and that data is available to evaluate the effectiveness of zoning and management plans, and to provide scientifically sound information to guide adaptive management.

The Investigator Marine Park is managed by South Australia. It represents a near pristine offshore environment and provides a reference site for the monitoring of other marine parks around the state. Within the Australian Government managed Western Eyre Marine Park, relatively little is known about the habitats, flora and fauna found in this region. This collaboration offered the opportunity to begin monitoring and research not previously undertaken in this marine park.



Map showing boundaries of South Australian and Australian marine parks

Expedition objectives

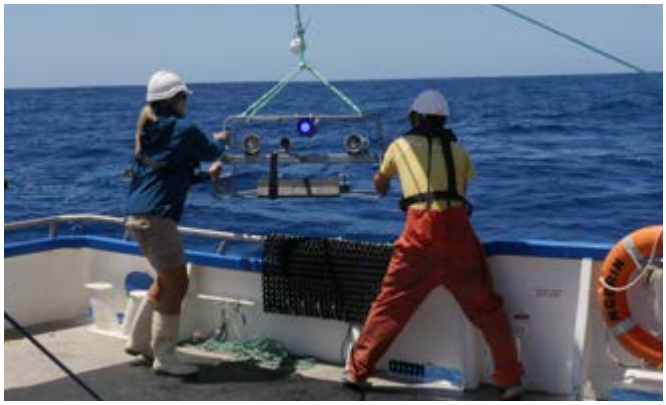
The collaborative expedition had a number of objectives including to:

- Provide critical ecological monitoring and baseline information of South Australian and Australian marine parks
- Provide valuable information on habitats and species for the future development of a management strategy in the Western Eyre National Park Zone
- Build on our understanding of benthic structure and habitats in Pearson Isles Sanctuary Zone and Western Eyre National Park Zone
- Contribute to our understanding of the connectivity and adequacy of South Australian and Australian marine parks
- Foster partnerships to support the implementation of South Australian and Australian monitoring, evaluation and reporting programs
- Communicate results to the public to raise awareness of South Australian and Australian marine parks.

Specific tasks undertaken on this expedition included:

- Deployment of baited remote underwater video systems (BRUVS) to measure fish abundance, diversity and size
- The use of swath (sonar) and inventory (video) mapping to determine the location, type and proportion of each habitat in the marine parks
- Deployment of acoustic receivers to monitor movement of large sharks and other tagged species
- Collection of sediment, seagrass, fish and invertebrate samples to assess condition, biodiversity and microplastic contamination
- The use of autonomous underwater vehicles to assess sea floor habitats.

For more information on methods see pages 8-9



DEW and SARDI staff retrieving a baited remote underwater video system used to capture images of fish

DEW and SARDI staff collecting benthic samples in the Pearson Isles Sanctuary Zone

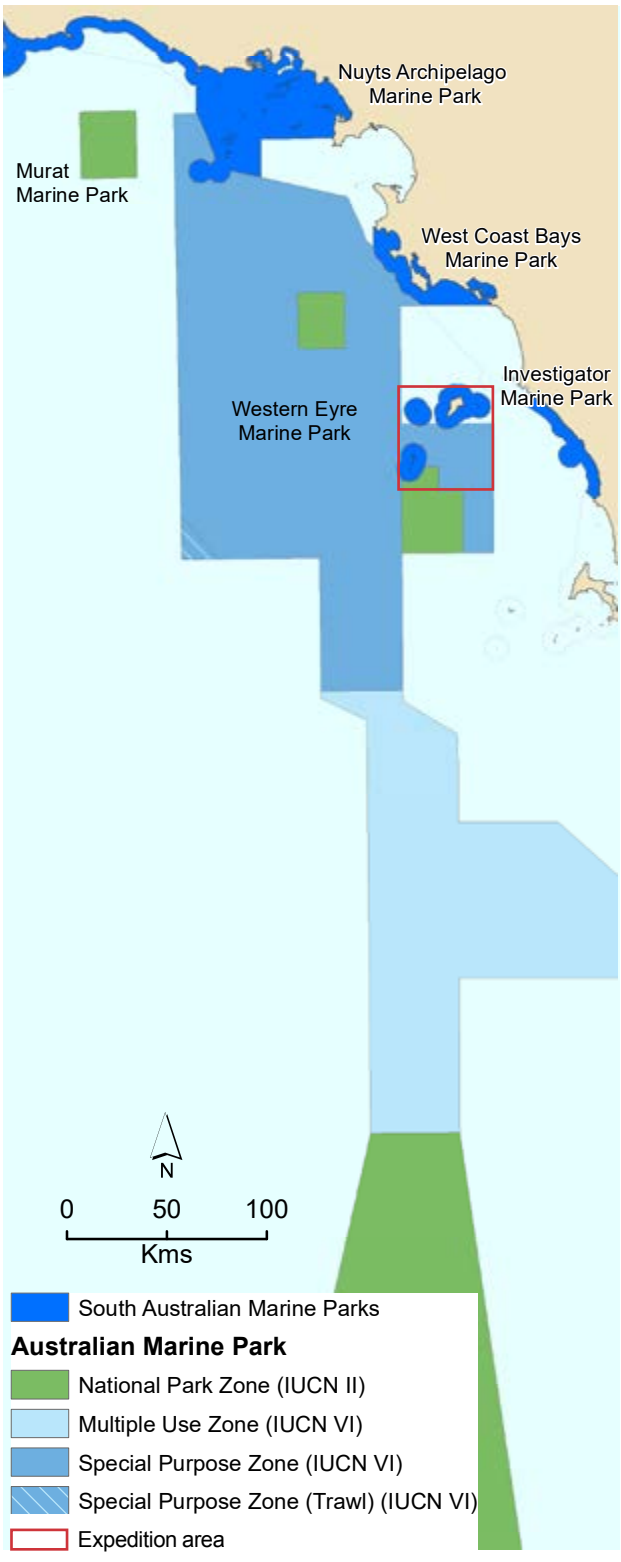
Mosaic sea star at Pearson Island

Western Eyre Marine Park

Western Eyre Marine Park is one of 58 Australian Marine Parks that protect Australia's offshore marine environment. Located off the western coast of the Eyre Peninsula, the marine park extends south, covering an area of approximately 58,000km^2. The marine park is divided into three management zone categories: national park, multiple use and special purpose (see map right).

The marine park is biologically rich and globally significant. Diverse seafloor features including canyons, ancient coastline and stretches of continental shelf break drive nutrient-rich upwellings and eddies. These productivity hotspots provide rich foraging grounds for a range of species including the Australian sea lion, sperm whale, white shark and small pelagic fish communities. Closer inshore, southern right whales calve between May and October. The seafloor also supports some of the world's most diverse soft-sediment ecosystems that teem with rich invertebrate life.

Western Eyre Marine Park is adjacent to three of South Australia's marine parks (Nuyts Archipelago, West Coast Bays and Investigator), and the Australian Murat Marine Park. Together these parks connect coastal and offshore environments across state and commonwealth waters and provide holistic protection for a broad range of habitats and interconnected ecosystems.



Map showing the location, size and zone types within the Western Eyre and Murat Marine Parks.

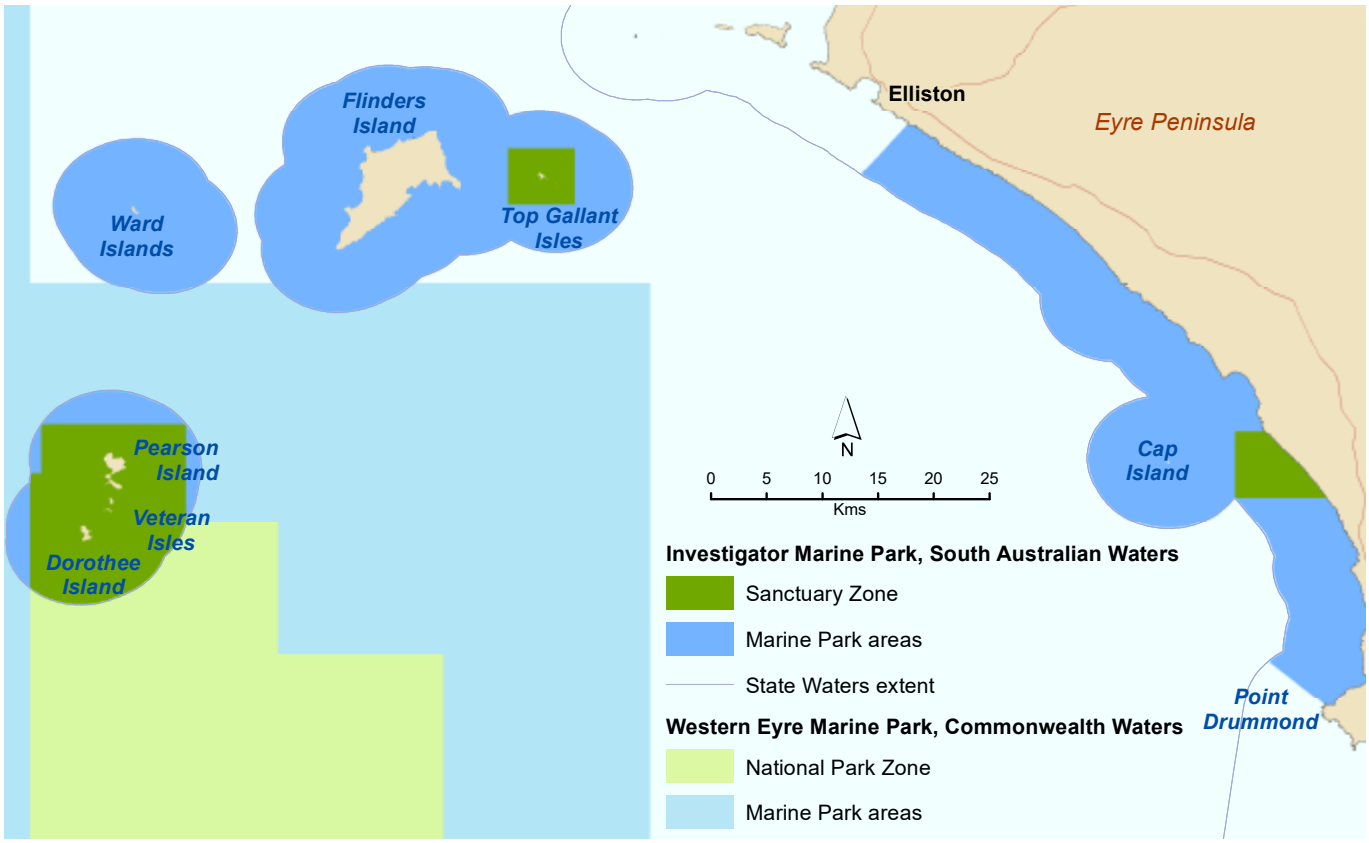
Investigator Marine Park

The Investigator Marine Park is located off the west coast of South Australia's Eyre Peninsula. The park covers 1,185km^2, over four areas, including south of Elliston to near Point Drummond and the offshore islands of the Investigator Group. The park includes three sanctuary zones including the Pearson Isles Sanctuary Zone (165km^2) where research and monitoring activities for this expedition were focused (see map below).

The Pearson Isles including Pearson, Veteran and Dorothee Islands, are protected in their entirety by the sanctuary zone. These Isles are geologically uncommon giant granite inselbergs (an isolated mountain rising abruptly from a plain) partially submerged by water. Waters are more than 50m deep within 500m from shore and the mountain of Pearson Island rises steeply to 200m above sea level (see image page 2). This extreme topography and isolated location means that these waters harbour prolific marine life. The crystal clear water of the Pearson Isles is strongly influenced by the warm Leeuwin current and support species from both temperate and tropical waters.

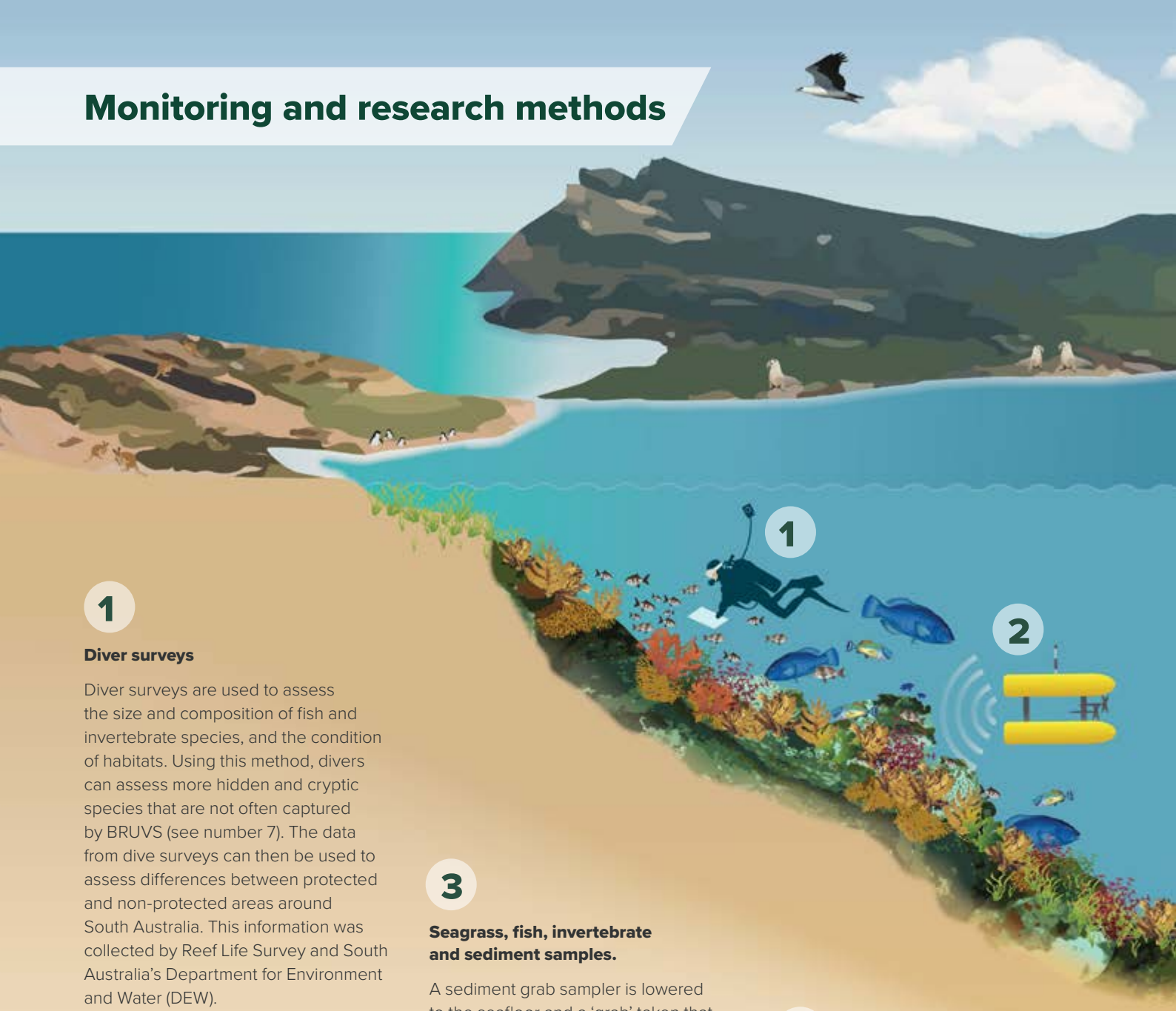
Complex habitats in the form of boulders, caves and tunnels are home to flourishing biodiversity and relatively intact ecosystems. Large blue groper, southern blue devil, diverse macro-algae, large sponges, gorgonian corals and soft corals are abundant in this marine park.

The Isles are also an important breeding and nesting area for many birds, including white-faced storm petrels, little penguins, short-tailed shearwaters, fairy terns and the endangered whitebellied sea eagle. The site is also important for migratory birds whose habitats are required to be protected under international treaties. The vulnerable Australian sea lion and the long-nosed fur seals both breed on these islands.



Map showing abutting boundaries of South Australian and Australian marine parks. National Park zones have the same high level protection status as South Australian sanctuary zones.

Monitoring and research methods



1

Diver surveys

Diver surveys are used to assess the size and composition of fish and invertebrate species, and the condition of habitats. Using this method, divers can assess more hidden and cryptic species that are not often captured by BRUVS (see number 7). The data from dive surveys can then be used to assess differences between protected and non-protected areas around South Australia. This information was collected by Reef Life Survey and South Australia's Department for Environment and Water (DEW).

2

Autonomous Underwater Vehicles

Unmanned vehicles are deployed to take comprehensive imagery of benthic habitats. This enables scientists to characterise and map the macrobenthos on deep water reefs. This information was collected by the Integrated Marine Observing System and the South Australian Research and Development Institute for South Australian and Australian marine parks.

3

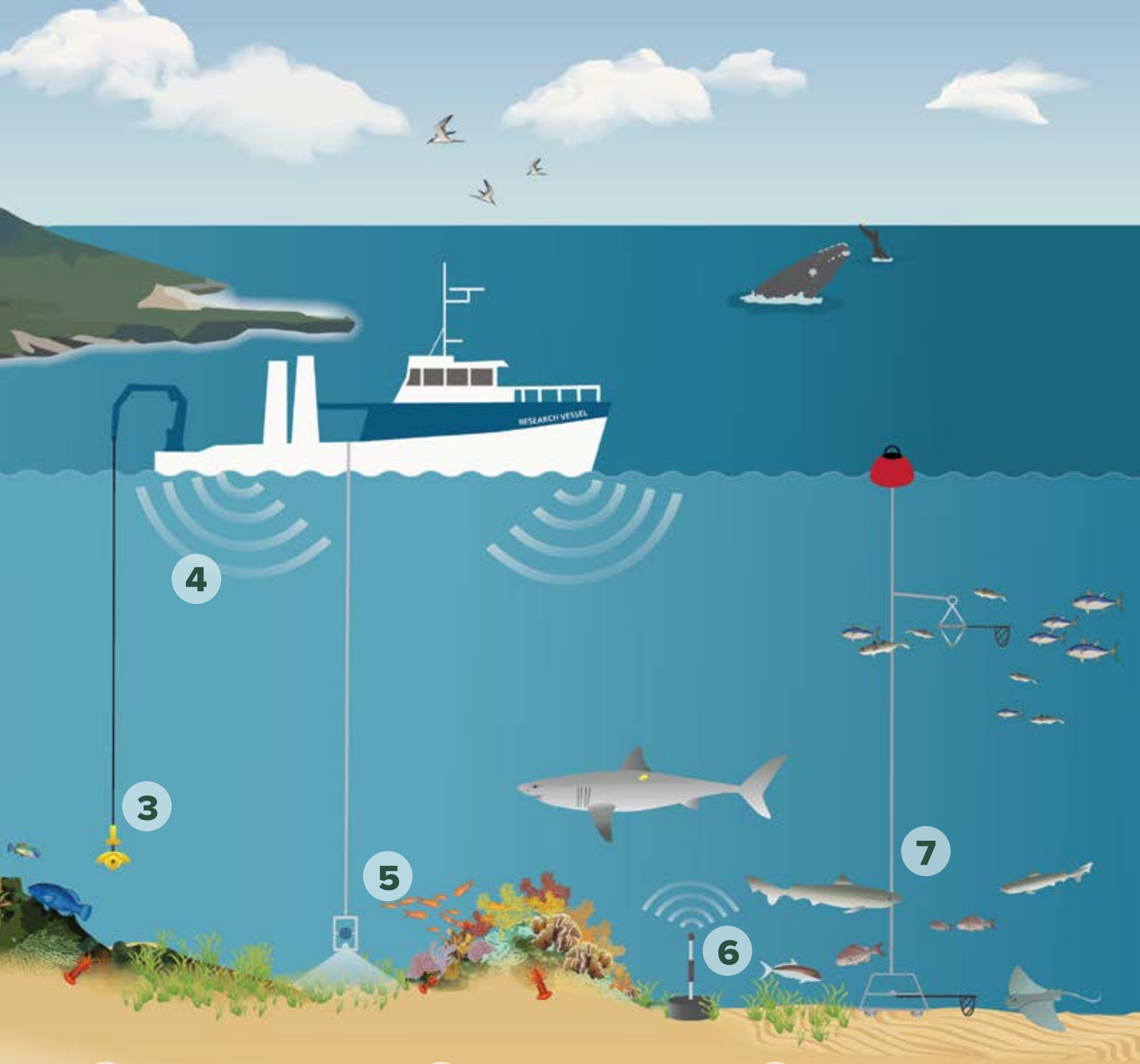
Seagrass, fish, invertebrate and sediment samples.

A sediment grab sampler is lowered to the seafloor and a 'grab' taken that contains seagrass, sediment, and any fauna living in this habitat. These samples provided previously unknown information about the biodiversity of the region and will be useful as historic records for comparison in the future. Seagrass can be compared with other areas of the state for condition and genetic relatedness. The samples were also analysed for microplastic contamination. Seagrass and sediment samples were collected by DEW and the University of Adelaide and then preserved for the State Herbarium, South Australian Museum and the EPA's aquatic ecosystem condition reporting program.

4

Multi-beam swath mapping

Swath mapping is used to record images of seafloor structures using sonar. This mapping is complementary to the inventory mapping (see number 5). Details such as depth and seafloor contour are used to generate 3D bathymetric and texture maps of the geological features. This detailed imagery is then used for ongoing management to assess if marine parks are in appropriate places, to help with selecting monitoring sites, and assist with the interpretation of monitoring data. Inventory and swath mapping were collected by DEW for South Australian and Australian marine parks.



5

Habitat inventory mapping

Inventory mapping is used to map large areas of seabed quickly. This mapping is complementary to the swath mapping (see number 4). An underwater camera was towed 1m above the seafloor for 50m at 2km grid intervals. Footage was sent via a live feed to computers on board the research vessel and revealed what type of habitat was in the area (e.g. reef, sand, seagrass or mud). This information was collected by DEW for South Australian marine parks.

6

Acoustic receivers

Acoustic receivers (or listening stations) collect information whenever an acoustically tagged fish or shark swims nearby. Receivers provide data on residency and migratory patterns, and can reveal if fish and sharks are using multiple marine parks (marine park connectivity). Acoustic receivers were deployed on the seafloor at key locations where they will collect data for months until they are retrieved. This information was collected and analysed by Flinders University and will help with marine park design and adaptive management.

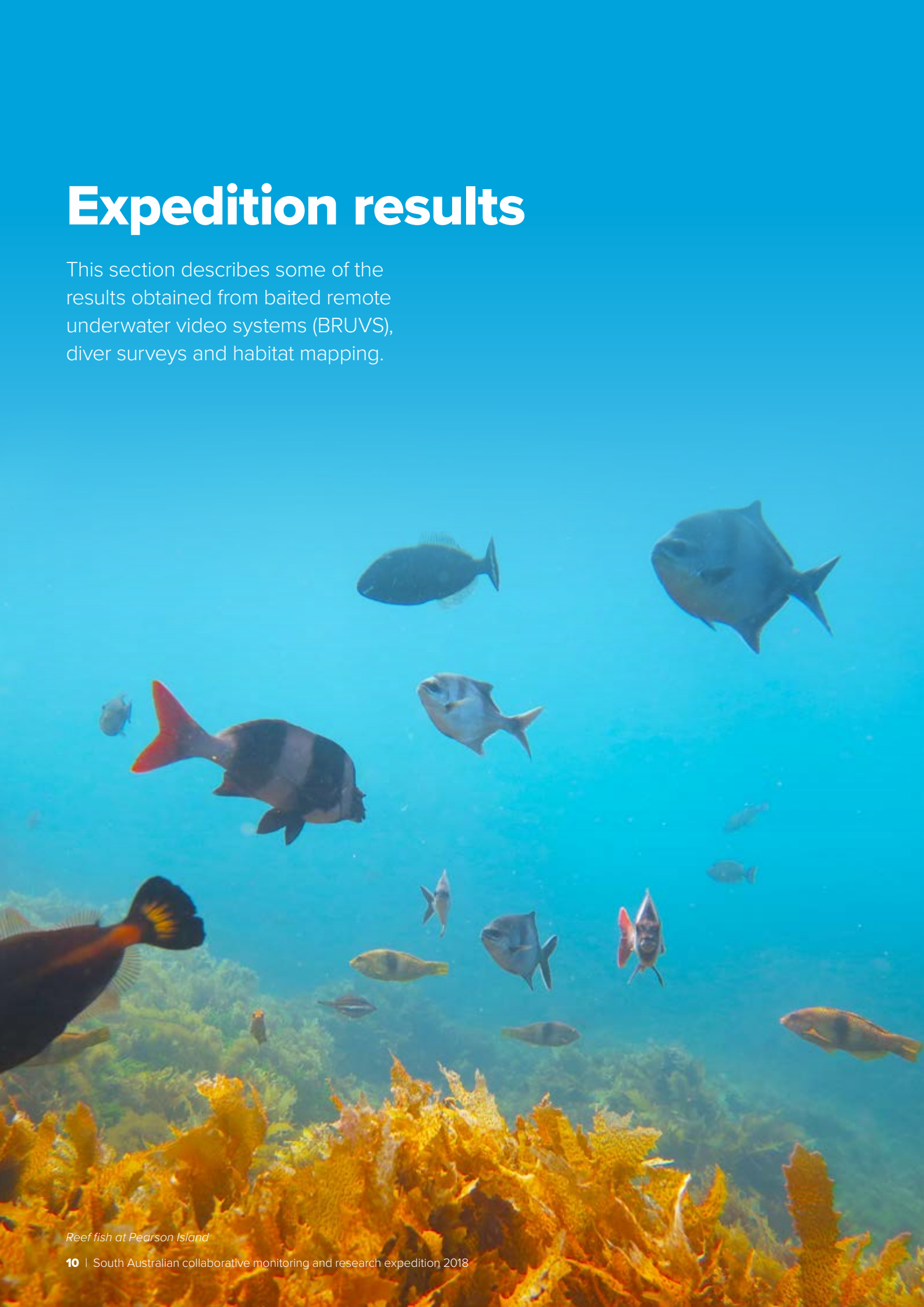
7

Baited Remote Underwater Video Systems (BRUVS)

Underwater cameras are lowered to the sea floor along with a bait bag to attract fish and invertebrates. BRUVS are particularly useful where diving is not appropriate, and can also be used in the pelagic zone. They also detect some species that are 'diver-shy' and not seen during diver surveys (see number 1). Footage from the videos was viewed and species, size and abundance was recorded. This information was collected by DEW for South Australian and Australian marine parks and will be used to monitor changes over time, and compare protected and unprotected areas.

Expedition results

This section describes some of the results obtained from baited remote underwater video systems (BRUVS), diver surveys and habitat mapping.



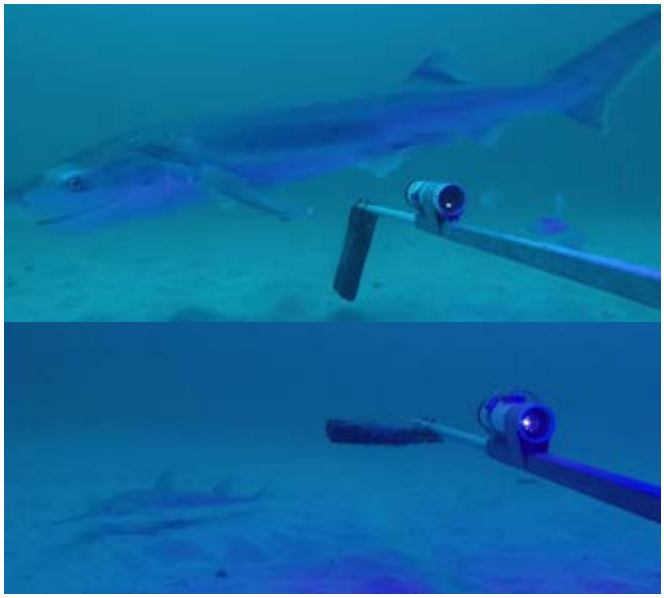
Reef fish at Pearson Island

BRUVS surveys – Western Eyre Marine Park

The expedition team deployed 16 benthic (seafloor) and 16 pelagic (upper water column) baited remote underwater video systems (BRUVS) to collect baseline data about the fish assemblages in the Australian Western Eyre Marine Park National Park Zone. The benthic BRUVS were deployed to a maximum depth of ~90m and each deployment recorded footage for one hour. Pelagic BRUVS were deployed to 10m and recorded footage for 2 hours.

The benthic BRUVS recorded 227 individuals, with 5 species of bony fish, 3 species of elasmobranchs (sharks and rays) and 1 species of crab (Table 1). The pelagic BRUVS recorded 392 individuals including leatherjackets, mackerels, cardinalfish, drummer and comb jellies (Table 2). By utilising a combination of pelagic and benthic BRUVS, researchers were able to capture different species assemblages which were representative of both of those environments.

SA Marine scientists went the deepest they had ever gone with BRUVS monitoring in depths of ~90m. Three species of shark were recorded from benthic BRUVS including a sawshark.



Photos top to bottom: Broadnose sevengill shark (Notorynchus cepedianus) and sawshark (Pristiophorus sp) captured on deep benthic BRUVS.

Table 1

Benthic species (seafloor)	
Common Name	**Max N***
Trevally	70
Broadnose sevengill shark	1
Ocean jacket	134
Gurnard perch	1
Toothy flathead	10
Sawshark	2
Gummy shark	6
Butterfly gurnard	2
Giant spider crab	1
	227

Table 2

Pelagic species (water column)	
Common Name	**Max N***
Jack mackerel	365
Trevally	1
Comb jelly	13
Trevalla sp.	7
Rough leatherjacket	2
Ocean jacket	1
Degen's leatherjacket	2
	391

**MaxN is a conservative measure of species abundance for BRUVS*

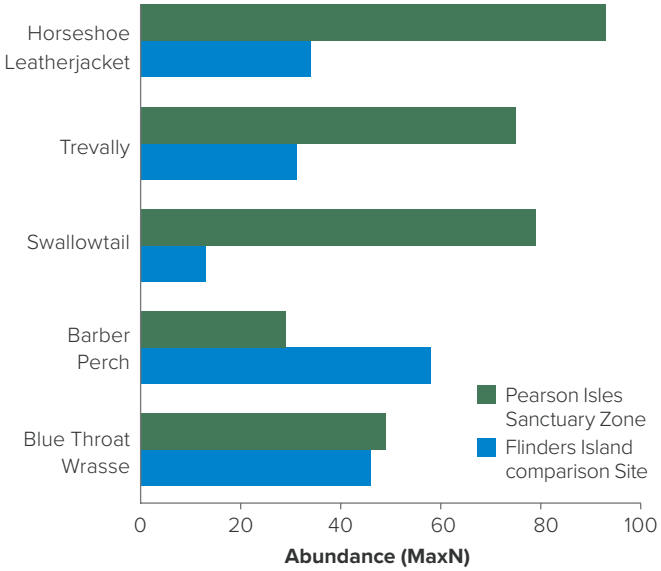
BRUVS surveys – Investigator Marine Park

Benthic BRUVS were deployed at 24 sites in the Investigator Marine Park, 12 inside the Pearson Isles Sanctuary Zone (SZ) and 12 as comparisons at Flinders Island (within a Habitat Protection Zone) on subtidal reef systems.

The data from BRUVS surveys contributes to the long term South Australian Marine Park monitoring program and is utilised to investigate fish assemblages across South Australia.

BRUVS surveys from Pearson Isles Sanctuary Zone showed higher abundance of fish compared to the comparison site (Figure 1), and higher fish diversity compared to other monitored areas around the state (Figure 2). The BRUVS surveys at Pearson Isles Sanctuary Zone also recorded the state's highest number of large fish. A total of 584 individuals, including 51 species of fish were observed. The most abundant species was the horseshoe leatherjacket *(Meuschenia hippocrepsis)* with 93 counted inside the sanctuary zone compared to 34 at the comparison site (Figure 1).

Fig 1 Abundance of the most common species observed from BRUVS surveys inside and outside of Pearson Isles Sanctuary Zone.



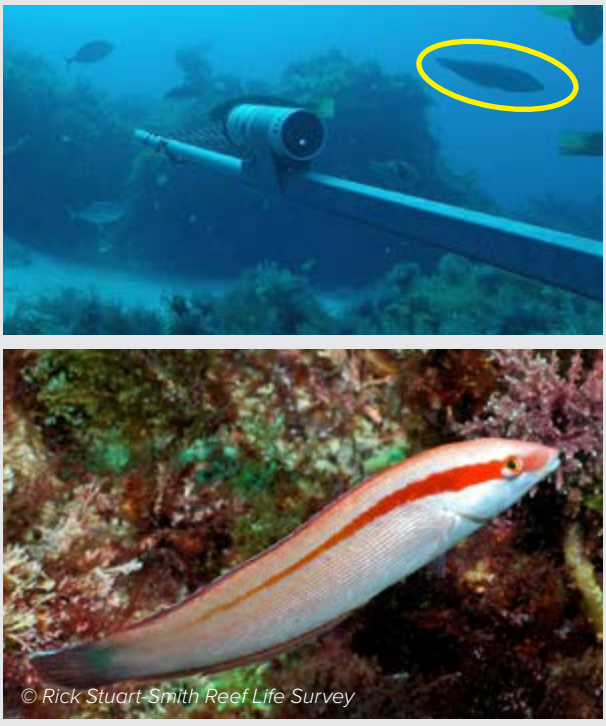
Big fish

The largest fish recorded by BRUVS at Pearson Isles SZ on this expedition was a samson fish *(Seriola hippos),* at 879mm followed by a queen snapper *(Nemadactylus valenciennesi),* at 749mm and western blue groper (*Achoerodus gouldii),* at 607mm.

Samsonfish, Seriola hippos recorded on BRUVS at Pearson Isles Sanctuary Zone.

Species range extension

BRUVS from the Pearson Isles recorded footage of the western king wrasse *(Coris auricularis).* This was the first recording of this species in SA, with previous records suggesting it was endemic to Western Australia.



Western king wrasse, Coris auricularis captured on BRUVS drop at Pearson Isles SZ.

Fish biodiversity

On average, 18 different species were observed per BRUVS drop in the Pearson Isles (Figure 2). Some of the most common species observed were the horseshoe leatherjacket, trevally and swallowtail. Having a higher number of species present in an ecosystem contributes to an increase in biodiversity which supports a more stable ecosystem that is resilient to environmental pressures. Understanding species diversity makes it possible to understand the 'trophic structure' of the population. Trophic structure describes what role organisms play in an ecosystem, e.g. are they primary producers (seagrass) or carnivores (predatory fish). Extensive removal of, or damage to, a particular trophic level or levels can change the natural state of these systems. Fish communities at Pearson Isles Sanctuary Zone can be categorised into 5 trophic categories based on the food they eat (Figure 3). The majority of fish species consumed invertebrates (e.g. blue groper, blue throat wrasse), macroalgae (e.g. leatherjackets) or other fish (e.g. kingfish)

Fig 2 Mean no. of fish species per BRUVS drop inside sanctuary zones across the SA marine parks network.

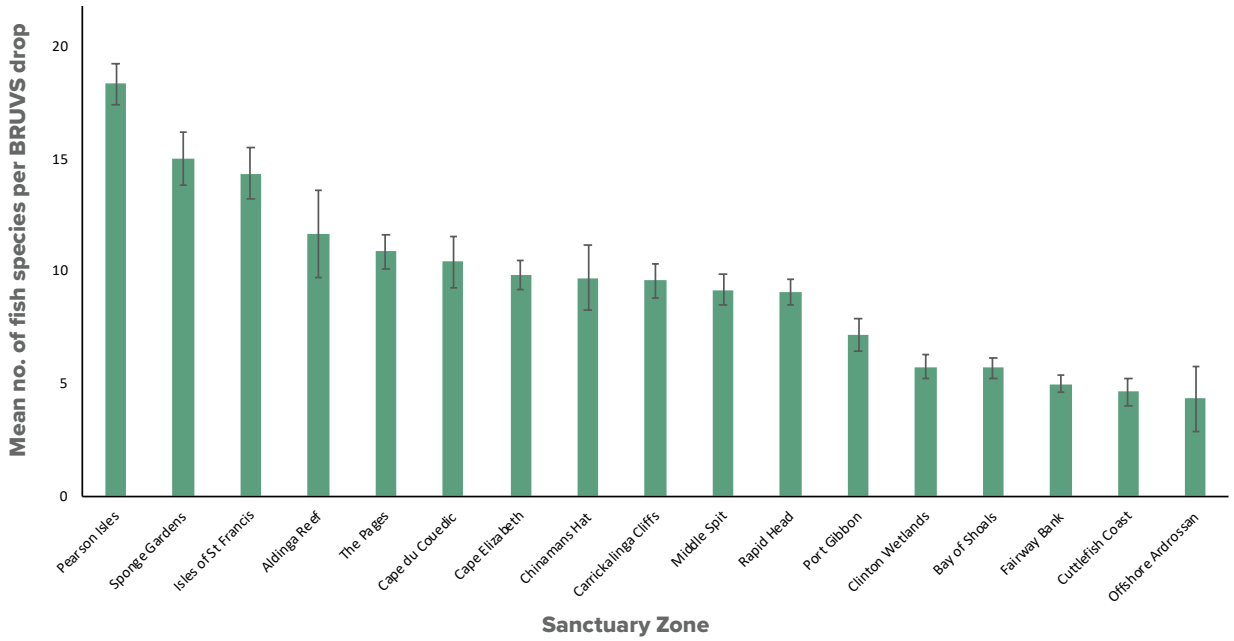
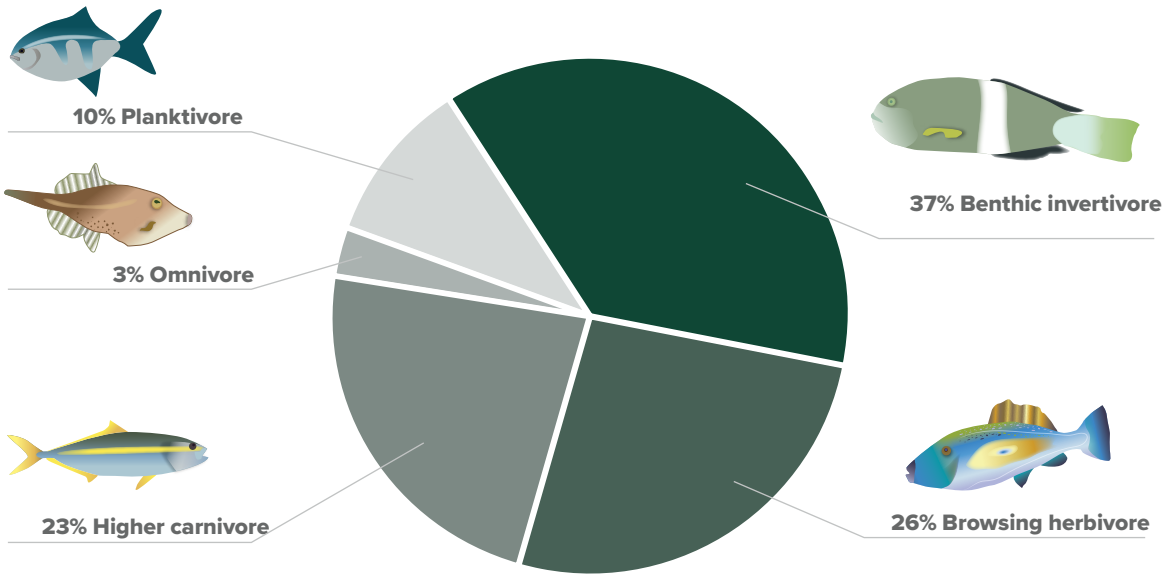


Fig 3 Percentage of feeding groups observed from BRUVS footage.



Reef surveys

In addition to this expedition, the rocky reefs of Pearson Isles Sanctuary Zone were surveyed by divers using the Reef Life Survey method during an expedition in early 2018. These reef surveys form part of the long term South Australian marine park monitoring program. Reef Life Survey is an International survey method for fish, macro-invertebrates and macro-algae undertaken throughout Australia in both state and Australian Marine Parks.

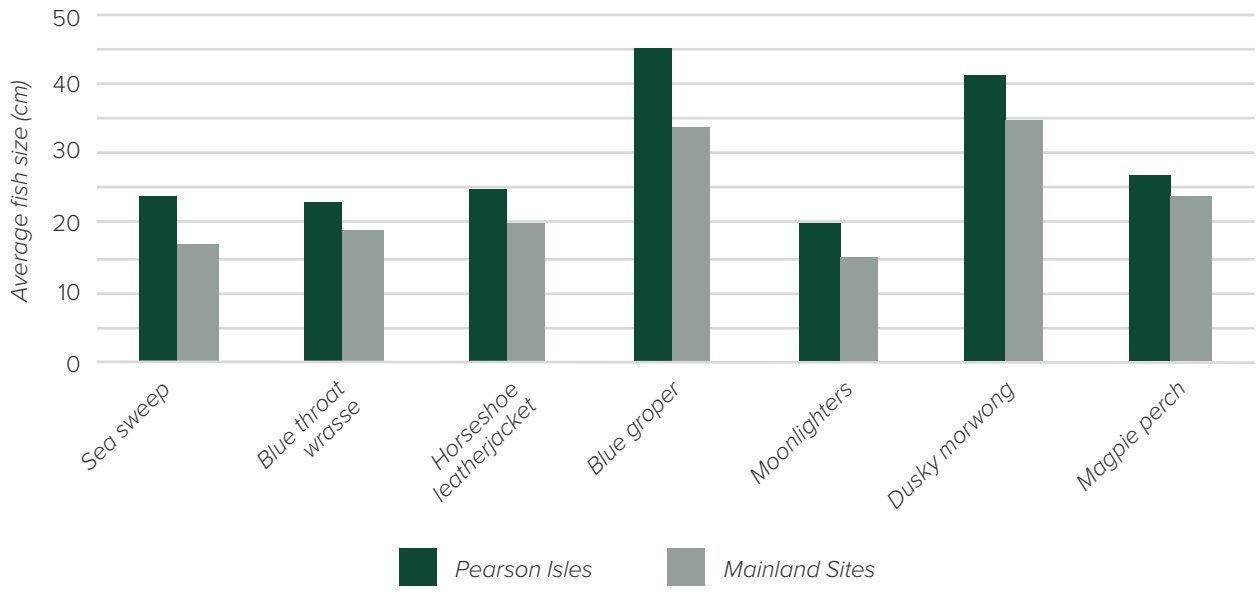
Pearson Isles supports some of the most diverse fish assemblages across South Australia. Results from dive surveys showed that the average size of many common species was larger inside Pearson Isles Sanctuary Zone when compared to other mainland monitoring sites (Figure 4). The average number of large fish (greater than 20cm) was also higher at Pearson Isles compared to other monitoring sites. These results highlight the productivity of the rocky reefs in this area, as larger fish generally produce more young and exert a greater influence in structuring marine communities.

Good light penetration associated with the excellent water clarity also results in highly productive macro-algal communities. Macro-algae are critical to rocky reef ecosystems as they provide habitat and food. Over 100 specimens were collected from Pearson Isles Sanctuary Zone for the South Australian Herbarium which will greatly improve our distributional knowledge of South Australia's macro-algae.

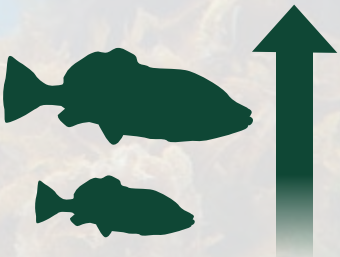
Pearson Isles has a particularly high abundance of blue groper (see page 16). Blue groper are the largest resident reef fish species in South Australia, growing up to 1.7m in length and reaching 70 years of age. Blue groper are carnivores and play an important role in regulating reef ecosystems.

Diver at Pearson Island

Fig 4. Average size of common fish species in Pearson Isles and South Australian mainland monitoring sites



Pearson Isles has high species diversity and an abundance of large fish.



Leatherjackets at the Pearson Isles were

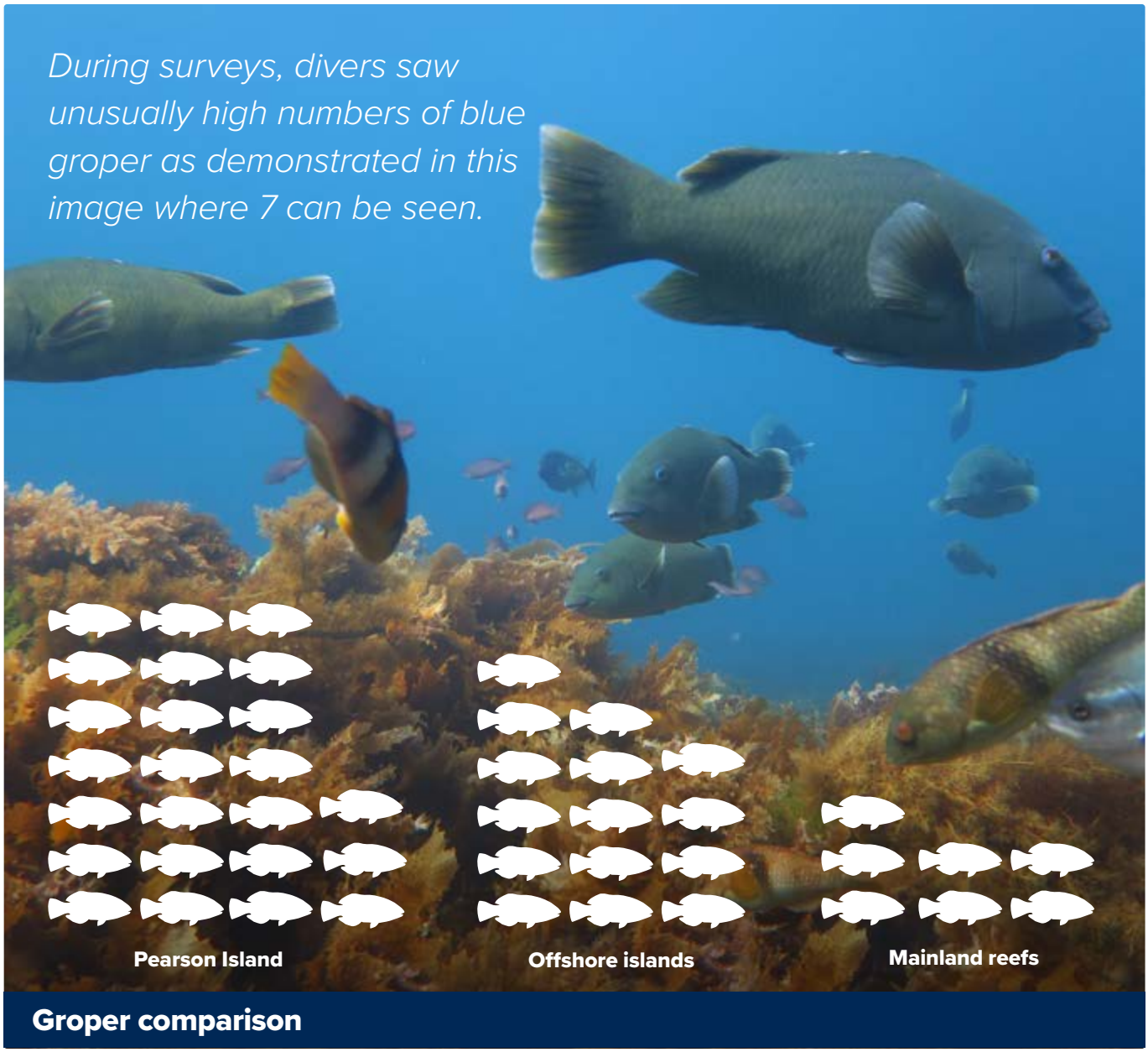
25% bigger

than other monitoring sites

Sea sweep at the Pearson Isles were

40% bigger

than other monitoring sites



High abundance of blue groper seen during diver surveys

Species range extension

The red banded wrasse (*Pseudolabrus biserialis*) was recorded for the first time in SA. This fish was previously thought to be endemic to waters of Western Australia where they are commonly found on inshore shallow reefs.

Red banded wrasse (Pseudolabrus biserialis) © Rick Stuart-Smith Reef Life Survey

Mapping the seafloor

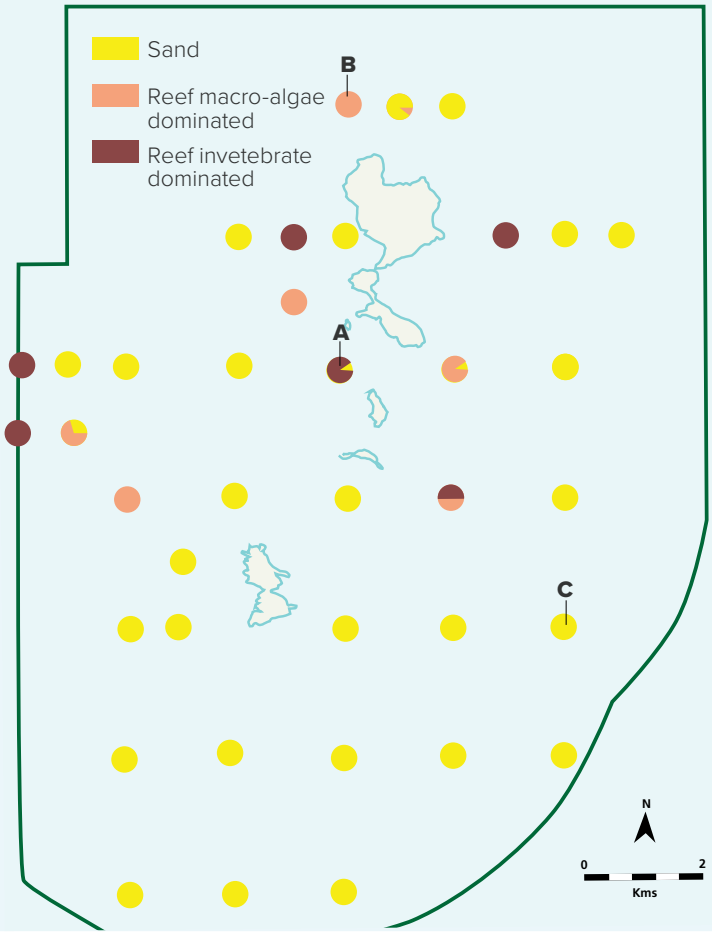
Inventory mapping conducted in the Pearson Isles Sanctuary Zone was performed by lowering a video camera with lights from the boat (image top right) to record images of seafloor habitats. Forty-four video drops were performed drifting over a distance of 50m, each at 2kms intervals. Thirty of the video drops were conducted at depths over 50m. These images were later classified into the appropriate habitat types (bottom right).

DEW staff retrieving inventory mapping camera

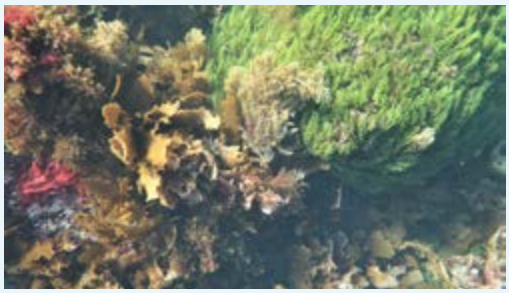
Habitat inventory mapping

Inventory mapping of the Pearson Isles Sanctuary Zone found significant reef habitat mostly surrounding the islands but with a few significant boulder reefs away from the isles. Shallower reefs (0-40m) were dominated by macro-algae while the deeper reefs (>40m) tended to be covered with dense sponge/invertebrate habitat. The rest of the zone consisted of sandy habitats (Figure 5 below).

Fig 5. Inventory mapping of Pearson Isles Sanctuary Zone with pie charts indicating proportion of habitat type seen at each site.



Example A *of sponge/invertebrate dominated reef in the Pearson Isles Sanctuary zone.*



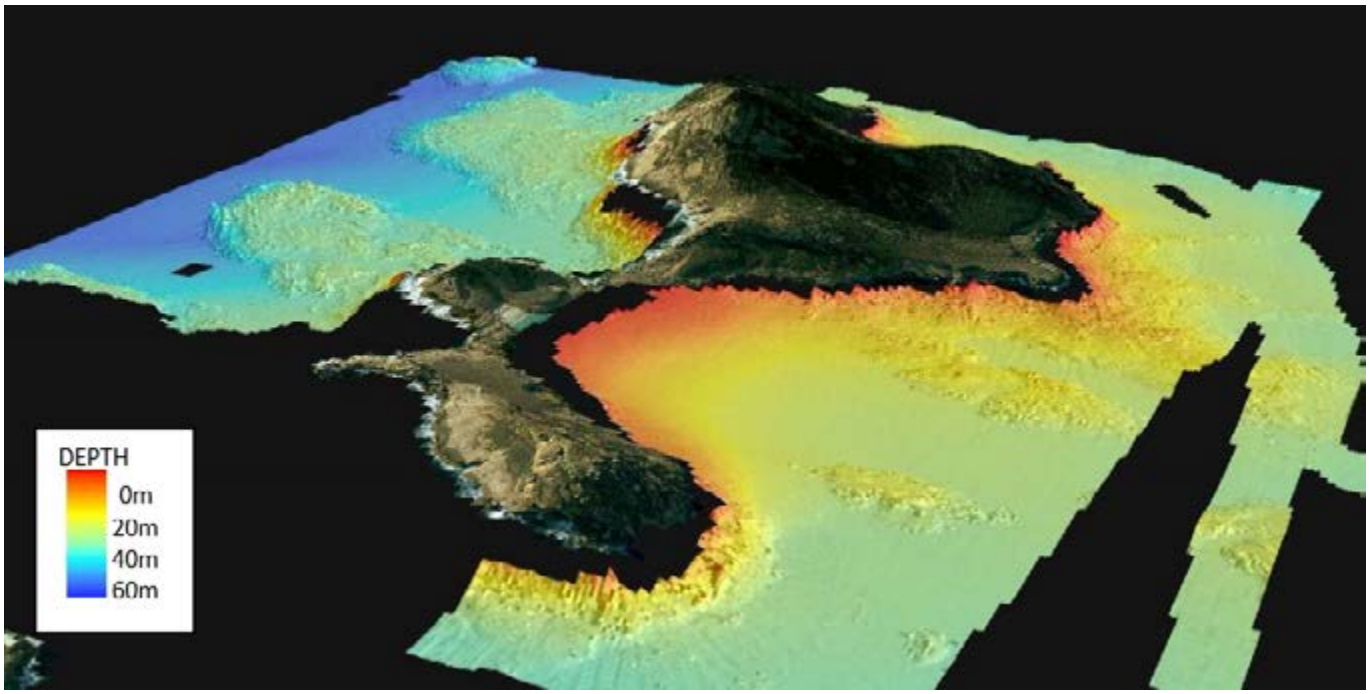
Example B *of macro-algal dominated reef in the Pearson Isles Sanctuary zone.*

Example C *of sand dominated habitat in the Pearson Isles Sanctuary zone.*

Swath Mapping Pearson Island

Swath mapping uses sonar (sound) to create a full cover model of the seafloor structure based on depth, hardness and roughness. The data collected can be used to create models of the seafloor (see image below), which infers information about the type of habitat. Knowing habitat type gives researchers a better understanding about the physical factors that influence seafloor ecology (e.g. topography, water movement, exposure to swell, shelter for fish and other organisms). This information is also used in conjunction with diver and video surveys to map the location, type, approximate extent and condition of marine habitats.

In the South Australian Pearson Isles Sanctuary Zone, approximately 17km^2 of seabed was mapped adjacent to the main northern islands. Exceptional conditions made it possible to map much of the western side of the island where significant areas of high relief reef stretched from the island shore to almost 70m deep. In some parts the reef on this side of the island rose up to 20-30m from the surrounding seafloor. On the north and eastern (sheltered) side of the island the two bays were mostly sand habitat that supported seagrass to as deep as 30m. Reefs on this side of the island were moderate to high relief and ranged down to 43m (image below).

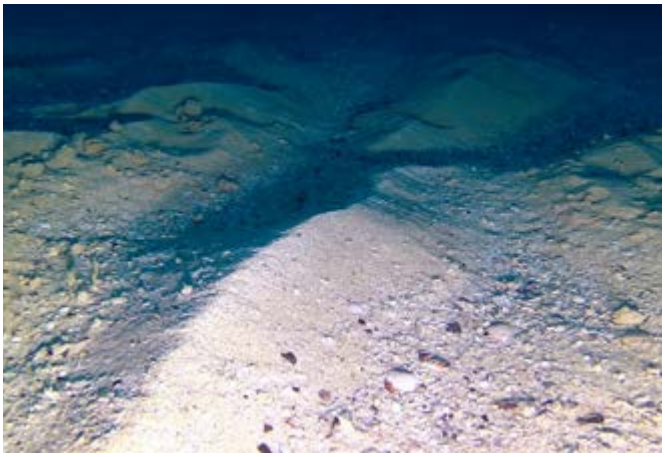


Swath mapping of Pearson Island showing depth contours

Swath mapping Western Eyre Marine Park

Approximately 15km^2 of swath mapping was also conducted in the Western Eyre Marine Park.

This mapping revealed that the sand habitats observed in the inventory mapping continued south of Pearson Isles and into the Western Eyre Australian Marine Park (see image right). These mesophotic sandy plains (80 – 90m deep) are an important feature of these marine systems and consist of sand drifts and shallow gullies. Knowing the habitats within the Australian Marine Park helps with understanding the type of ecological communities that are occupying the marine park.



Colonial ascidians at Pearson Island

A collaborative approach

This expedition was a collaboration between the South Australian Department for Environment and Water (DEW), and the Australian Government (Parks Australia), South Australian Research and Development Institute (SARDI) Aquatic Sciences, South Australian Environmental Protection Authority (EPA), University of Adelaide, Flinders University and the Integrated Marine Observing System (IMOS).

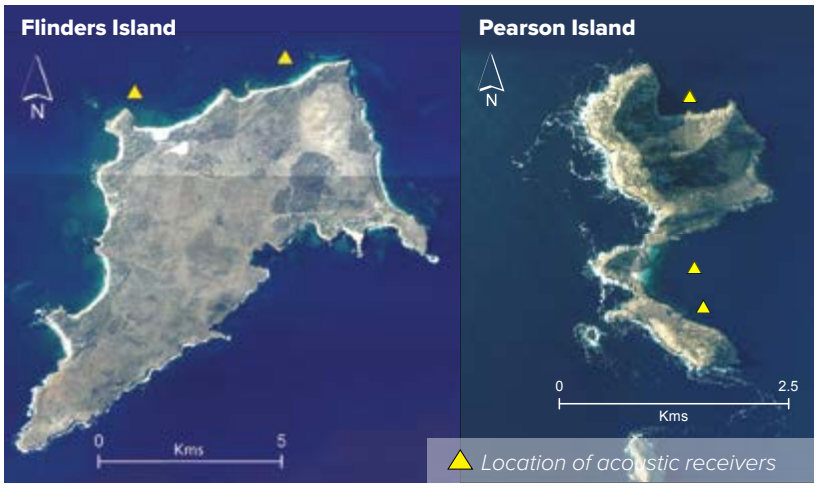
The following section highlights the collaborative research and monitoring undertaken by DEW's expedition partners.

Some of the researchers at Flinders Island

Flinders University – acoustic receivers tracking migration of sharks

Over 1,000 acoustic receivers are currently deployed throughout Australia. Five receivers were deployed in the Investigator Marine Park and will contribute to the national network of acoustic receivers managed by the Integrated Marine Observing System (IMOS) Animal Tracking Facility.

IMOS provided the receivers to the project. Data logged on the receivers will be used to determine the residency and migratory patterns of tagged megafauna in Australia and the connectivity between South Australia's marine parks. This information will help in assessing the adequacy of marine park design to protect these animals. The receivers will also be able to track other species that have been tagged in marine parks such as yellowtail kingfish.



Maps showing location of acoustic receivers deployed on Flinders and Pearson Islands

Acoustic receivers were deployed to collect data on residency and migratory behavior of fish and sharks

Image: White shark fitted with acoustic tag © Andrew Fox -Rodney Fox Shark Expeditions

University of Adelaide sample collections

Representative samples of macro-algae, seagrass, fish and invertebrates were collected by the University of Adelaide. Seagrass samples were collected as part of a broader research project investigating the genetic relatedness and connectivity of seagrasses in South Australia. These samples will be stored at the South Australian State Herbarium. Opportunistic samples of macro-algae were also collected. Twenty-four fish and 61 sediment samples were collected throughout the Western Eyre and Investigator Marine Parks as part of a separate PhD study. These samples will be tested to establish if micro-plastic contamination is occurring in South Australia's remote environments. Five different species of fish were provided to the South Australian Museum along with numerous invertebrate species collected from sediment samples.

Invertebrate fauna from sediment samples

South Australian Environment Protection Authority seagrass sampling

The expedition allowed for opportunistic seagrass sampling by the South Australian Department for Environment and Water that will aid the Environment Protection Authority with their long term seagrass monitoring program. During the expedition, 16 grab samples were collected in the two sheltered bays on Pearson Island. The samples will be assessed for condition and pollution markers. The opportunity to sample seagrass from remote locations means that scientists have a better benchmark to compare seagrass condition across other parts of the state.

Processing of seagrass samples

Integrated Marine Observing System integrated benthic monitoring program

This program began in 2009 to monitor and track changes in sea floor habitats. The data is collected with autonomous underwater vehicles (AUV) and provides baseline ecological information to monitor the long term effects of climate change and human activities. This collaboration provided an opportunity to attempt the deployment of an AUV over the deep water reefs in the Pearson Isles Sanctuary Zone and the Western Eyre Marine Park. Unfortunately poor weather hampered attempts to deploy the AUV and the planned monitoring could not be successfully completed.

Autonomous underwater vehicle ready for deployment

Ocellate sea star at Pearson Island

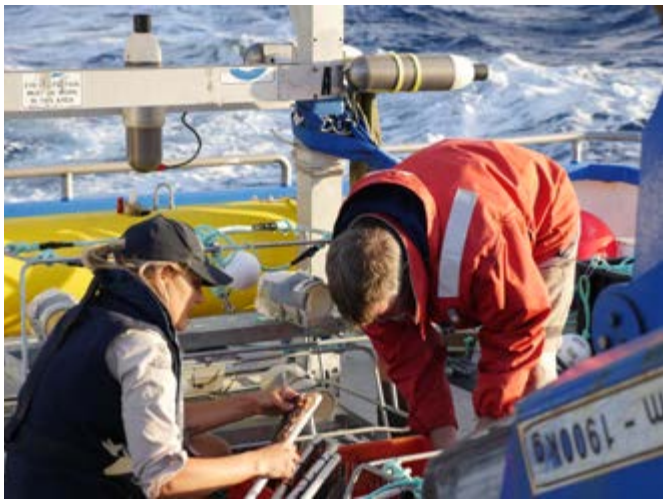
A successful expedition

Many partners contributed time, data and expertise to build an understanding of how marine parks are performing. The opportunity for university and government scientists to participate in research in offshore areas is rare and makes a collaborative approach one of the key aspects to undertaking a successful expedition such as this one.

The results from this expedition have greatly contributed to our understanding of the biodiversity in these marine parks. We now have a better understanding of the parks ecosystems and the data collected forms part of ongoing monitoring of marine parks.

Diver surveys and BRUVS provided observations of two species previously not thought to be found in South Australia. These results reveal that red banded wrasse and western king wrasse have a greater distribution than previously thought and that offshore islands are home to many species. The expedition also achieved the deepest benthic BRUVS deployment in the waters off South Australia and recorded mesophotic species such as the sawshark and butterfly gurnard, which are not typically seen on shallower subtidal BRUVS. Mapping enabled scientists to gain a better understanding of the location and types of habitats that support aquatic communities in these marine parks. The shallower waters of Investigator Marine Park contained seagrass, diverse reefs and sponges, and transitioned to fine and coarse sandy habitats in the deep waters of the Western Eyre Marine Park.

This expedition has contributed important baseline and monitoring information to inform the future management of these parks.



The collaboration between South Australian and Australian government agencies, universities and non-government organisations was critical to conducting a successful research expedition.

Research vessel Ngerin off the coast of Pearson Island

More information

www.environment.sa.gov.au/contact-us

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