The Great Australian Bight Research Program

Building a bigger picture of the Bight

2013-2017

The Great Australian Bight Research Program

Program findings 2013—2017

The Great Australian Bight Research Program is a collaboration between BP, CSIRO, the South Australian Research and Development Institute (SARDI), the University of Adelaide, and Flinders University. The Program aims to provide a whole-of-system understanding of the environment, economic and social values of the region; providing an information source for all to use.

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The Great Australian Bight Research Program has transformed the deep ecosystems of the Great Australian Bight from one of Australia's least studied environments to one of the most well known.

Right:
The Great Australian Bight extends from Cape Pasley, WA to Cape Catastrophe, South Australia. The 100 m, 1000 m and 4000 m isobaths and Australia's Economic Exclusive Zone across southern Australia are shown.

INTRODUCTION

The Great Australian Bight extends from Cape Pasley, Western Australia to Cape Catastrophe, Kangaroo Island, South Australia.

This unique marine environment is part of the world's longest southern-facing coastline, contains significant natural resources, and is of global conservation significance.

More than 85 per cent of known species in the region are found nowhere else in the world. The Great Australian Bight provides critical habitats and migration pathways for iconic species and predators at the top of the food chain (apex predators), including Australian sea lions, white sharks, and pygmy blue whales. Australia's largest and most valuable stocks of fishes in the open sea (pelagic fishes), especially Australian sardine and southern bluefin tuna, occur in the Bight, and there are important coastal fisheries for crustaceans (e.g. southern rock lobster, prawns and crabs), molluscs (e.g. abalone) and finfish (e.g. snapper, King George whiting, garfish and flathead), with the majority of South Australia's valuable aquaculture farming residing in the coastal waters off Eyre Peninsula. The Great Australian Bight is also considered to be one of the most prospective under-explored oil and gas provinces in the world.

Indigenous communities have strong cultural connections to the region, and many coastal towns rely on the pristine marine environment that supports aquaculture, fisheries, recreational fishing and tourism industries.

Prior to the Great Australian Bight Research Program (GABRP), relatively little was known about the region. Previous research focused mainly on coastal and shelf waters, while the deep-water ecosystems of the Great Australian Bight were poorly understood. The GABRP has transformed the ecosystems of the Bight from one of Australia's least studied deep sea environments to one of the most well-known.

The GABRP was established in April 2013 to develop scientific knowledge, tools and baselines to inform and support future use, development, management and conservation of the socio-ecological systems of the Great Australian Bight. The Program provided new knowledge on the structure and function of the Bight's ecosystems; on the nature and value of its marine industries, including its potential hydrocarbon reserves; and on the dependence of associated coastal communities on the amenities provided by the environment.

The four-year, $20 million social, environmental and economic study brought together multi-disciplinary research teams comprising more than 100 scientists and technical staff. It was undertaken as a collaborative program involving BP, CSIRO, the South Australian Research and Development Institute (SARDI), the University of Adelaide, and Flinders University.

New scientific knowledge developed in the GABRP includes:

- Improved understanding of the ocean processes underpinning the ecosystem.
- New insights into what drives productivity in the open ocean.
- Greater awareness of the region's biodiversity, especially in the deep ocean beyond the continental shelf.
- Identification of at least 277 species that are new to science, and almost 887 species not previously reported in the Great Australian Bight.*
- Improved understanding of the biology and ecology of the region's marine mammals, seabirds and sharks.
- Improved understanding of the migratory and foraging patterns of southern bluefin tuna.
- Collation of historical information on seismic activity in the Great Australian Bight.
- Confirmation of oil and gas characteristics in the Great Australian Bight.
- Improved understanding of the values and priorities of people living in the Great Australian Bight's coastal townships.

The Program also developed valuable new scientific tools that provide a significant legacy for future scientific studies, monitoring programs and management advice.

*Combined data from the Great Australian Bight Research Program – a collaboration between BP, CSIRO, SARDI, the University of Adelaide and Flinders University and the Great Australian Bight Deepwater Marine Program – a collaboration between Chevron and CSIRO.

How the waters of the
Great Australian Bight work

The Great Australian Bight has unique ocean features, experiences some of the biggest waves in the world, and hosts the world's longest west-east running continental shelf.

OCEAN PHYSICS

The broad-scale movements of the oceans off Australia's south coast and its effects on marine ecology and biodiversity have been understood for some time; however, knowledge gaps existed due to a lack of *in-situ* ocean data and high-resolution computer models.

Researchers in the GABRP's Physical Oceanography Theme used three hydrodynamic models (two shelf-focused, ROMS and SHOC and one deep-sea focused, BRAN) to understand seasonal, inter-annual and spatial circulation patterns in the Bight and provide knowledge to underpin other studies in the GABRP, and help future research. Models were validated using all available data, including observations made by BP and the Integrated Marine Observing System (IMOS). Moored instruments, ocean gliders, surface buoys, satellites, radars and even seals recorded ocean conditions at many locations and depths over recent years.

Shelf-focused models simulated tidal signals and wind forced motions, as well as seasonal variability observed by moorings during 2011–14. The deep-sea focused global model (BRAN) provided tools to examine longer time scales, enabling inter-annual variability due to the Leewin Current and far field El Niño events to be identified.

Shelf-focused model results matched well with observed variability in shelf ocean currents for depths less than 300 m. Model results for winter and summer aligned with our previous understanding of circulation in the Bight, however model results were obtained at a higher resolution and with more realistic forcing and initial fields of stratification.

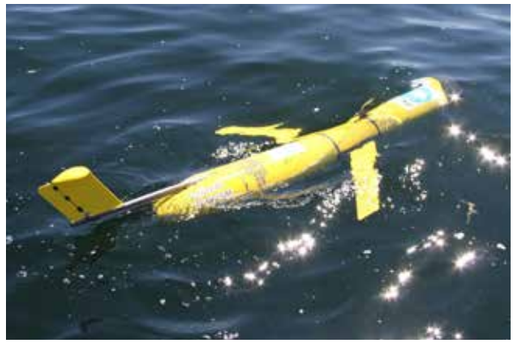
Strong evidence was found across the models for a deep (500 m) westward Flinders Current, previously not recorded.

In the eastern Bight, the winds and ocean currents cause an upwelling of nutrient-rich water to the surface in summer. Westward winds from large high-pressure systems drive coastal upwelling and a westward Coastal Current in the central to eastern Great Australian Bight.
A southward transport of water in the central Bight 'collides' with the equatorward deep ocean transport, producing downwelling year-round at the shelf edge, and a ridge in sea level that in part drives the South Australian Current to the east against the prevailing winds. In addition, new results show that the South Australian Current is also enhanced by a shelf edge gradient of seawater density.

In winter, the Great Australian Bight's circulation is driven by eastward winds, the eastward shelf edge Leeuwin Current, and deep upwelling 200-800 m below the surface in the west. Near the coast, eastward winds drive an eastward Coastal Current. Shelf downwelling is expected from eastward shelf currents and the formation of dense (cold, salty) water along the coast, where evaporation exceeds precipitation year-round.

The effect of waves on hydrodynamic processes was investigated because of the significant year round swell in the Bight. Explicitly including the effect of waves did not improve the ability of the models to simulate the Bight's hydrodynamics, but waves were found to principally effect the long term drift at the surface.

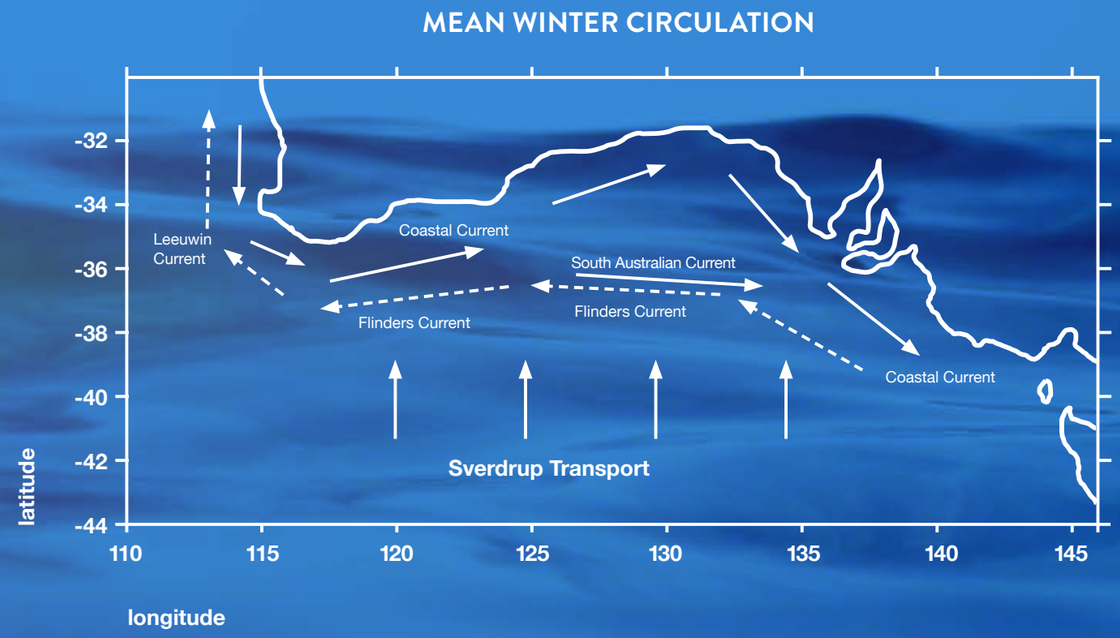
The improved understanding of circulation and nested suite of improved hydrodynamic models has advanced our understanding of physical processes in the Great Australian Bight. These new tools enabled the tracking of particles to determine the likely sources of naturally occurring hydrocarbon deposits collected from southern beaches as part of the GABRP, and in future will assist studies of recruitment pathways for commercial fish stocks.

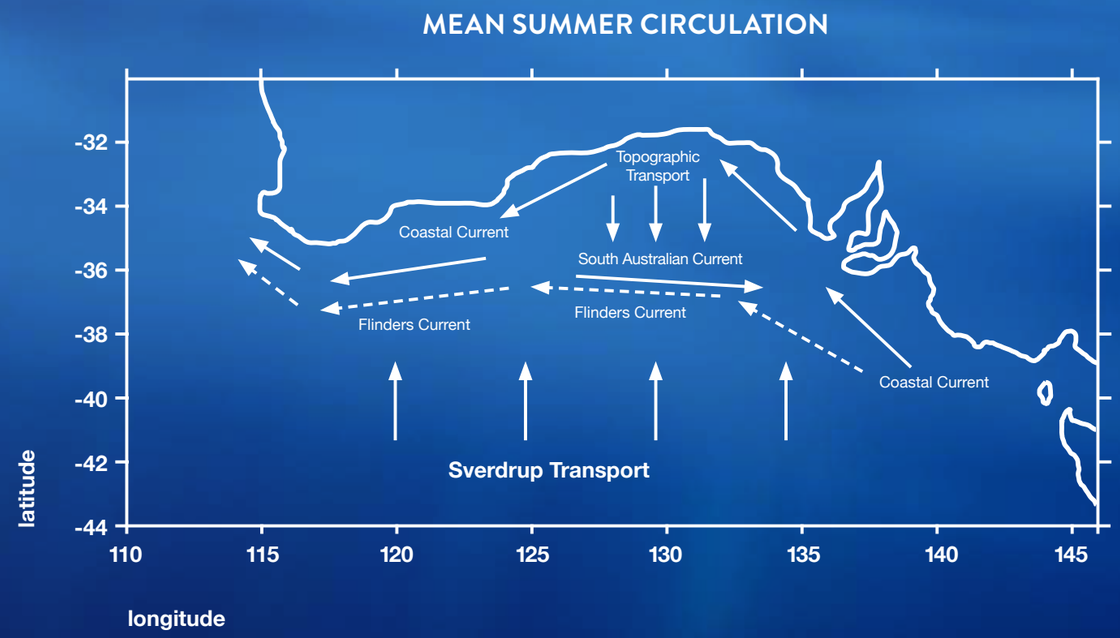


Above:
Oceanographic data was collected by gliders from the Integrated Marine Observing System's (IMOS) Australian National Facility for Ocean Gliders (ANFOG).

Ocean Physics

Development and analysis of deep-sea and shelf focused hydrodynamic models provided an in-depth understanding of the oceanography of the Bight.





Hydrodynamic models developed through the GABRP have dramatically improved our understanding of circulation in the Bight. **Above:** Mean Winter Circulation. **Below:** Mean Summer Circulation.

Understanding productivity
and the ecosystem

The Great Australian Bight is an important feeding and breeding ground for many economically valuable species, including Australian sardine and southern bluefin tuna.

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OPEN WATER RESEARCH

Researchers in the GABRP's Pelagic Ecosystem and Environmental Drivers Theme compared food web structure and productivity in the eastern and central Bight.

Findings provided important insights into the structure and function of the Great Australian Bight's ecosystems, including shelf waters and the deep continental margin. The researchers used physical, chemical and biological data collected from the SARDI RV *Ngerin* during routine surveys at the Kangaroo Island National Reference Station (NRSKAI, part of the National Reference Station Network of IMOS, together with remote-sensed daily primary productivity data supplied through the Australian Ocean Data Network (AODN), and wind data from the Bureau of Meteorology, to investigate seasonal changes in food web structure in the eastern Great Australian Bight. They found that the microbial food web, underpinned by picophytoplankton (<2 µm), is present year-round in the eastern Bight, as a background signal underlying other important food webs in the region; effectively "keeping the lights on" in productivity terms. The dominant food web in the eastern Bight, supporting moderate rates of primary productivity year-round, is a food web based on nano-phytoplankton (2-20 µm), which is previously undocumented in the region. The efficient classic food web based on microphytoplankton (>20 µm) only occurs during upwelling, when enrichment drives high rates of primary productivity. The efficient food web based on microphytoplankton (>20 µm) only occurs during upwelling, characteristic of the eastern Great Australian Bight in summer, when dominant enrichment drives high rates of primary productivity.

Nine days of pelagic plankton and micronekton sampling undertaken from the Marine National Facility RV *Investigator* during December 2015 indicated that there may be different enrichment mechanisms driving primary productivity in the central and eastern Great Australian Bight during the upwelling season. In the east, upwelling produces sporadic and at times intense enrichment, whereas in the central Bight biological processes appear to have a stronger influence, with only intermittent input from turbulent fluxes at the shelf edge. Investigations of nutrient sources and trophic pathways undertaken using stable isotope analysis supported the finding that the main nitrogen source in the east was upwelled water, while in the central Bight it was consistent with biological processes. Researchers concluded that the efficient, classic food web dominates in the eastern Great Australian Bight during periods of nutrient-rich upwelling, but higher than anticipated nitrogen concentrations in the central Bight support unexpected types of plankton, which transfer energy quickly through the food web.

Long-term patterns in primary productivity are similar in the eastern and central Great Australian Bight, particularly on the upper slope. Rates of primary productivity in the east are highly variable, with the highest rates created by upwelling. In the central Bight, primary productivity is more moderate, but linked to a more constant, biologically-mediated supply of nitrogen that is sustained over long periods. The central Bight is a more important contributor to overall productivity in the region than first thought.

The biomass, size and species composition of small marine organisms (micronekton) in the eastern and central Great Australian Bight were similar, with fish being the dominant taxonomic group. Krill dominated the shelf break and upper slope. Researchers observed large numbers of fish schools over the upper-slope and offshore in the central Bight. Gelatinous species were an important component of the micronekton in this region.

The researchers discovered two species of gelatinous organisms that are new to science. They also reported three species in the Southern Hemisphere for the first time, three species in Australia for the first time, and 10 first reports in The Great Australian Bight, bringing the region's known species of gelatinous organisms to 140. The team also developed a new acoustic and optical probe for investigating the gelatinous community.

Right:
A profiling multi-frequency acoustic and optical system was used to detect and quantify micronekton (small fish, squids, crustaceans and larger gelatinous organisms, such as the siphonophore, *Praya reticulata* shown on the left).

Left:
Deep-sea voyages were a key component of the Program to characterise the pelagic and benthic communities, and identify key ecological processes in the central and eastern Great Australian Bight.

Above:
Water sampling at different depths helped identify changes in food web dynamics.

CENTRAL GREAT AUSTRALIAN BIGHT

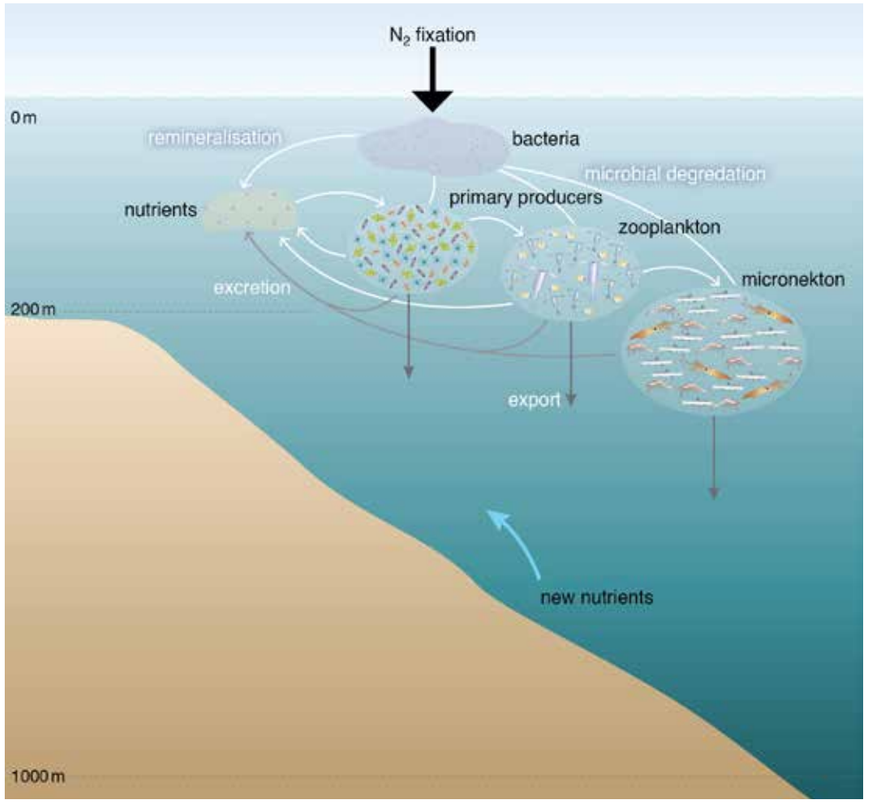
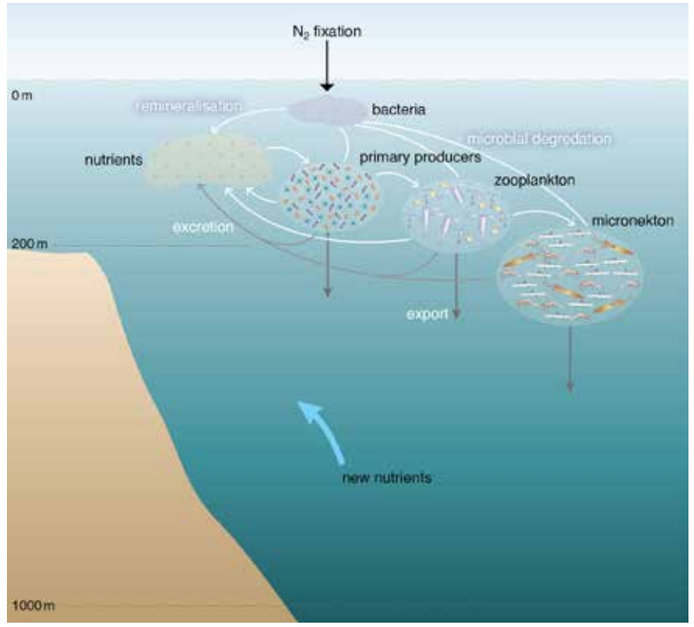


Diagram of functioning of the upper slope Great Australian Bight highlighting dominant production drivers. **Above:** Central Great Australian Bight where nutrient supply is constant but constrained and biological processes dominate nitrogen supply supporting production. **Below:** Eastern region where nutrient supply is characterised by addition of pulses of upwelled nutrients with a reduced pathway of biological processes. In general zooplankton and micronekton biomass is similar in the eastern and central region.

EASTERN GREAT AUSTRALIAN BIGHT



Research has improved our understanding of food web dynamics that underpin total ecosystem productivity in the Great Australian Bight. Upwelling was found to be the dominate enrichment process in the east, whereas the discovery of new biologically mediated enrichment processes revealed higher than expected productivity in the central Bight.

Mapping life in the deep sea

Researchers in the GABRP's Benthic Biodiversity Theme transformed the region from having Australia's least-known to best-known deep-sea fauna.

SEA-FLOOR BIODIVERSITY

Prior to this research, almost nothing was known about what lived on the Great Australian Bight's sea-floor in depths greater than 200m.

Researchers investigated the diversity, distribution and ecology of groups of organisms on the sea-floor of the Bight's continental slope. They found a high level of biodiversity, identifying 277 species new to science and 887 species new to the Great Australian Bight.* Systematic surveys of sea-floor (benthic) organisms undertaken from the Marine National Facility RV *Investigator* in 2015 (both Great Australian Bight Research Program and Great Australian Bight Deepwater Marine Program) and RV *Southern Surveyor* voyage in 2013 were the deepest that have been undertaken in Australian waters.

Sea-floor sampling led to the collection of 63,340 benthic invertebrate specimens, comprising 1,073 species, 602 genera and 357 families, from 11 phyla. These samples provided the first information on the composition, abundance and distribution of infauna, epifauna, fishes and microbes in the central Great Australian Bight's deep waters. Depth plays a dominant role in structuring most groups of organisms.

The 200 multi-corer samples taken at the 30 sites yielded 1,303 individual infauna specimens, representing at least 258 species. Abundance of organisms was related to depth, with a decrease in abundance in waters deeper than 400 m. Samples collected in 2013 and 2015 differed, indicating substantial variability over time.

More than 44,000 specimens and 600 species (11 phyla) of invertebrate epifauna (megafauna greater than 10 mm in length) were collected in 30 beam trawls. Approximately one quarter of species were undescribed and an additional 77 species were new records for Australian waters. Sponges and echinoderms dominated the overall biomass and density, with the former being more prominent in shallower waters. Species richness and abundance varied with depth. Only two species were found that appear to only occur in (are endemic to) the Great Australian Bight: the crab *Choniognathus granulosus* and barnacle *Arcoscalpellum inum.* The assemblage (or groups) of organisms in the region resembles more closely those in the southern Pacific Ocean than in the Indian Ocean.

The beam trawls took a total of 108 species of fishes from 49 families in depths of 200 to 3000 m. Most species occurred infrequently. The great majority of species had been previously recorded from Australian waters (90 per cent) and the Great Australian Bight (75 per cent). A lower proportion of previously recorded species occurred at greater depths (1700 to 3000 m), where there had been virtually no sampling prior to the GABRP (74 per cent previously recorded in Australian waters, and 30 per cent in the Bight waters). The fauna is dominated by families that typically occupy the deep ocean: rat-tails (Macrouridae), cut-throat eels (Synaphobranchidae), morid

** Combined Great Australian Bight Research Program and Great Australian Bight Deepwater Marine Program data.*

Below:
Left to right: Deep-sea ghost flathead, mysid prawns and giant hatchet fish.

cods (Moridae), oreo dories (Oreosomatidae), slickheads (Alepocephalidae), cusk eels (Ophidiidae) and halosaurs (Halosauridae). The Macrouridae was the most diverse and abundant group in waters 400 m and deeper.
Endemic species were most prevalent in shelf break (200 m) and upper- to mid-slope (400-1500 m) depths, and declined with increasing depth. Fish biomass was significantly related to depth, being relatively low at 200 m, highest at 400 m, then steadily declining to 3000 m.

Researchers in the Benthic Biodiversity Theme also undertook the first study of deep-water hydrocarbon-degrading microbes in temperate Australia. They used molecular techniques to find and characterise the unique groups of hydrocarbon-degrading microbes in the Great Australian Bight. They found bacterial species related to known hydrocarbon-degraders.

These endemic microbes are likely to have the capacity to degrade hydrocarbons, and could play an important role in degrading spilled oil.

The study also identified key habitats, communities and species, developed maps of distributions, and evaluated methods for monitoring future changes in status. Data from unperturbed sites provided the basis for evaluating indicators and metrics for future comparisons. The benthic habitat models and molecular identification tools are significant legacies for future science and monitoring programs in the region.

Research discovers nearly 277 new species living in the depths of the Great Australian Bight and found 887* species in the region for the first time. This new understanding of sea-floor animals has transformed the Bight into one of the best-understood deep-sea regions in Australia.

** Combined Great Australian Bight Research Program and Great Australian Bight Deepwater Marine Program data.*

Below:
Two deep-sea voyages on board Australia's national research vessels, previously the *Southern Surveyor* and more recently the RV *Investigator*, characterised the deepwater pelagic and benthic community structure, and identified key ecological processes in the central and eastern Great Australian Bight. This information will assist in developing a whole-of-system understanding of the region, which will inform future integrated and sustainable management.

Left:
A polychaete, *Paradiopatra* species, found in the sediments at depth in the Great Australian Bight (Photo: Hugh MacIntosh, Museum Victoria).

Right:
A decapod, *Mundia* species, one of the 1,073 benthic species identified from 63,000 specimens collected from depths of 200 to 4,500m in the Bight.* (Photo: Hugh MacIntosh, Museum Victoria).

Above:
An isopod, *Plakolana* species. In total 277 new species were found in the depths of the Great Australian Bight.* (Photo: Hugh MacIntosh, Museum Victoria).

Tracking and understanding predators and their habitats

Field surveys and tagging programs conducted during the GABRP's Ecology of Iconic Species and Apex Predators Theme provided new information about the distribution, abundance and movement of several iconic species.

ICONIC SPECIES AND APEX PREDATORS

New information collected includes the first abundance estimates for common dolphins in the eastern Great Australian Bight and for two colonies of flesh-footed shearwaters and little penguins on offshore islands.

Researchers undertook the first surveys of the occurrence and distribution of baleen and toothed whales in offshore shelf and slope habitats, including the first characterisation of the foraging habitats of sperm whales. Inshore aerial surveys in the coastal and shelf waters out to 100 m depth between Ceduna and Coffin Bay identified five species of cetaceans, including southern right whales *(Eubalaena australis)*, humpback whales *(Megaptera novaeangliae)*, minke whales *(Balaenoptera* sp.*)*, short-beaked common dolphins *(Delphinus delphis)* and bottlenose dolphins *(Tursiops* spp.). Researchers estimated the presence of 20,000 to 22,000 short-beaked common dolphins in coastal waters, demonstrating the importance of the eastern Great Australian Bight for this species.

Offshore aerial surveys focusing on the shelf break and 200 m depth contour counted 58 cetaceans, comprising at least eight species (including blue whales, *Balaenoptera musculus brevicauda*; a fin whale, *Balaenoptera physalus*; sperm whales, *Physeter macrocephalus*; pilot whales, *Globicephala melas*; killer whales, *Orcinus orca*; Risso's dolphins, *Grampus griseus*; short-beaked common dolphins; and common or offshore bottlenose dolphins).

An offshore visual and acoustic survey in an area of the shelf break and slope of the eastern Bight detected vocalisations of odontocetes (toothed whales) and sperm whales, and sightings of sperm whales, pilot whales, and a beaked whale.

Researchers conducted an offshore pelagic survey between the du Couedic Canyon, south west of Kangaroo Island, and the continental shelf break south of Head of Bight. Longline sets caught five pelagic shark species, including blue shark *(Prionace glauca)*, shortfin mako *(Isurus oxyrinchus)*, common thresher *(Alopias vulpinus)*, bigeye thresher *(A. superciliosus)*, and school shark *(Galiorhinus galeus)*.

Satellite tags deployed on sharks (blue, shortfin mako, white and bigeye thresher) showed they traversed widely but there was evidence of species-specific preferences for particular habitats and depths. The occurrence of the predominantly subtropical and tropical bigeye thresher shark in the Bight, and its subsequent migration to waters off Exmouth, Western Australia, was a new scientific discovery.

Right:
The Great Australian Bight is critical to the Australian sea lion, with most of its breeding occurring in the region. However, there is concern over the species' status as population numbers continue to decline.

A comprehensive synthesis of recent and historic surveys highlighted that the Great Australian Bight supports 93 per cent and 98 per cent of Australian populations of Australian sea lion *(Neophoca cinerea)* and long-nosed fur seal *(Arctophoca forsteri)*, respectively. In contrast, only 18 per cent of the population of Australian fur seal *(Arctocephalus pusillus doriferus)* occurs in the region.

Populations of long-nosed fur seal (114,540 individuals; 24,063 pups) and Australian fur seal (14,811 individuals; 3291 pups) have largely recovered from historical sealing. However, populations of the threatened Australian sea lion are smaller than previously estimated (10,728 individuals; 2801 pups) and undergoing a rapid decline. The rate of decline across the Great Australian Bight was equivalent to a 76 per cent decrease over three generations (~38 years), meeting the IUCN criteria for 'Endangered'. The integration of existing data on populations of Australian sea lions, long-nosed fur seals and Australian fur seals is a significant legacy from the GABRP that will enhance their future management.

Researchers recorded crested terns at six islands. Comparisons with results from earlier surveys suggest a potential decline in little penguins since 2004 of 80 per cent at Olive Island and 66 per cent at Pearson Island. The first quantitative surveys of flesh-footed shearwaters estimated 928 and 5785 breeding pairs at Lewis and Smith Islands, respectively; the only known breeding sites for the species in the eastern Great Australian Bight.

A second project combined at-sea movement data from nine iconic and apex predator species that use the Bight to create one of the world's largest tracking databases. Data from satellite tracking and GPS tags obtained between 1995 and 2016 were collated for Australian sea lions, long-nosed fur seals, Australian fur seals, short-tailed shearwaters, little penguins, white sharks, blue sharks, shortfin mako sharks and southern bluefin tuna. Aerial survey and historical presence data for pygmy blue whale and sperm whales were also collated.

Analysis of 4924 tracks and over 15,000 observations from aerial surveys and historical data identified species that permanently reside in the Great Australian Bight or use it periodically for feeding or breeding as part of broad-scale migrations. Individuals of some migratory species are present in the Bight region year-round, while others are present only in summer to autumn.

Below:
Models using historical data collected over 13 years provided a new understanding of the movement, feeding and diving behaviour of southern bluefin tuna in the Bight. Additional tags, deployed as part of this Program, will potentially extend the time series to ~30 years.

Above:
98% of Australia's long-nosed fur seal population are in the Great Australian Bight. Females feed in shallow shelf waters near colonies in summer and offshore waters in winter.

Models were developed to predict the general distribution and foraging habitats for the 11 key iconic and apex predator species identifying shared foraging habitats and key regions used by many species in the eastern central and western Great Australian Bight. Results confirmed the region is highly significant, both in the national and global context, for many marine predators.

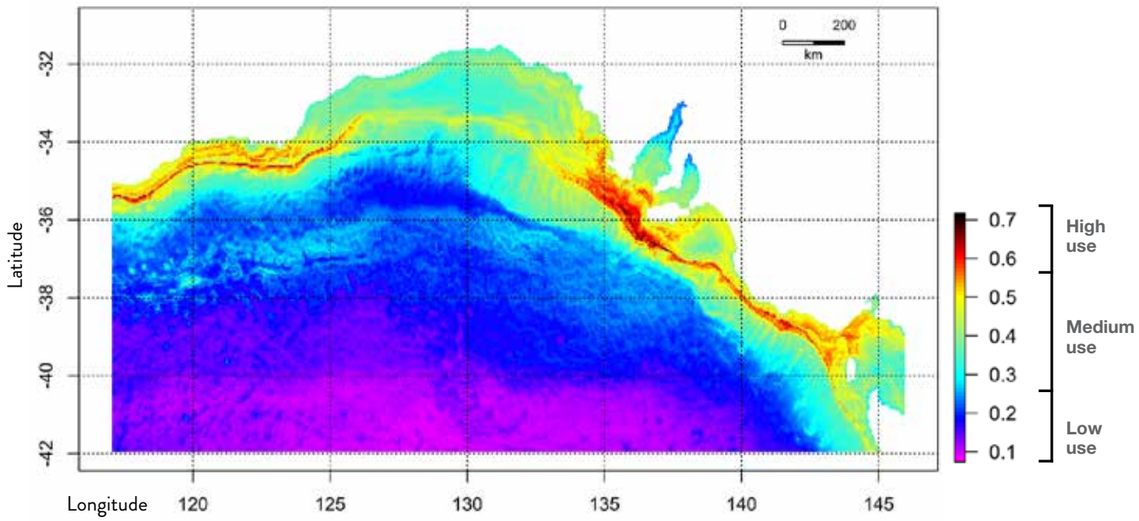
Another project investigated historical patterns in the movement, behaviour and preferred habitats of juvenile southern bluefin tuna in the Great Australian Bight. Southern bluefin tuna are one of Australia's most valuable fisheries, and 95 per cent of the commercial catch is from the Bight.

Researchers developed improved statistical methods for estimating the position of southern bluefin tuna from archival tags, and for examining their feeding, habitat preferences and seasonal distribution, providing new insights on their migration patterns and feeding behaviour. Data from 110 archival tags deployed from 1998 to 2011, and an additional 125 electronic tags deployed in 2014 showed that their migrations were highly variable between individuals, with the individuals themselves changing paths from year to year. The Great Australian Bight represents a region of global importance for southern bluefin tuna, which consistently use the Bight from summer to autumn.

While the proportion of time that juvenile southern bluefin tuna spent in surface waters in the Great Australian Bight varied, most occurred at depths of 50 m or less throughout the day and night. However, they spent more time at the surface during the day. Most feeding occurring around dawn in shallow depths.

The timing of feeding suggests that juvenile southern bluefin tuna track their prey visually. Dawn and dusk periods are likely to provide enough light for identifying and pursuing prey. Juvenile southern bluefin tuna in the Bight spend a large proportion of the day at the surface; this may be a form of behavioural thermoregulation, allowing them to increase their body temperature, which could increase digestion and growth rates above levels that could be achieved in other coastal or oceanic environments.

Below:
The continental shelf and shelf break in the eastern and western Bight were identified as high usage based on data collected from Australian sea lions, Australia fur seals, long-nosed fur seals, little penguins, short-tailed shearwaters, blue shark, shortfin mako sharks, white sharks, southern bluefin tuna, sperm whales (presence only data) and blue whales (presence only data).



Distribution and foraging maps of apex predators and iconic species demonstrate the importance of the Great Australian Bight, both in the national and global context, for many marine species.

- Australian sea lions
- Long-nosed fur seals
- Australian sea lions
- Mako sharks
- Blue sharks
- White sharks
- Little penguins
- Short-tailed shearwaters
- Crested terns

Identifying petroleum systems and tracking hydrocarbons

Oil and gas exploration has occurred in the Great Australian Bight for years. The GABRP's Petroleum Geology and Geochemistry Theme investigated the occurrence and potential mechanisms of hydrocarbon seepage, and measured hydrocarbon concentrations in the Bight Basin.

PETROLEUM GEOLOGY AND GEOCHEMISTRY

Geochemical analysis of the composition of liquids and gases provided a clearer understanding of possible source rocks that generated hydrocarbons, including the eastern Ceduna/Duntroon Sub-basins.

This research Theme has significantly enhanced prospectivity and reduced exploration risks within the Bight Basin.

To understand the distribution of hydrocarbons in sediments, researchers used multi-disciplinary approaches including structural and geomechanical evaluation, seismic data, identification of seabed features, and sampling of the sea-floor in areas of possible seepage and far field locations. The deep-water slope of the Ceduna Basin includes features with the highest potential for fluid leakage. Researchers identified three sea-floor areas where reconnaissance for potential seepage could be undertaken. Data collected during two voyages provided no evidence of seepage; however, the Basin is large so an absence of seepage in the Great Australian Bight has not been confirmed. Qualitative organic geochemical analyses of organic matter isolated from seawater, seabed sediment, net samples and headspace gases indicate that petroleum hydrocarbons are below the limits of detection. This suggests an absence of hydrocarbon seepage in and around the sampling region.

A second project investigated the distribution, composition and likely origins of coastal bitumen strandings along South Australian beaches. It provided the first multi-year geospatial, geochemical and oceanographic study of the stranding of coastal bitumen (asphaltite and tar balls) on representative beaches along the entire South Australian coastline. Researchers sampled 31 beaches after winter in 2014, 2015 and 2016, yielding a total of 631 specimens – the largest collection from an Australian region.

Tar balls (waxy bitumen) mainly strand in the upper parts of south west facing ocean beaches and are most common on the Limestone Coast, in the south east of the state. Denser asphaltites tend to accumulate on beaches with a northwest aspect, and are more common along the west coast of the Eyre Peninsula.

Above:
Fluid inclusion methodologies identified traces of oil in sediments, such as sand, as well as analysing their geochemical characteristics and entrapment history.

Tar ball and asphaltite strandings have declined over the past 20-plus years, suggesting reduced seepage and, in the case of tar balls, improved environmental practices for tanker washing and oil spillage in Indonesian waters.

One soft asphaltic bitumen recovered from the Limestone Coast was unique, and likely to be a product from a Cretaceous marine source rock similar to that which gave rise to the asphaltites; this suggests the existence of an active petroleum system in the Bight Basin. At least two waxy bitumen sub-families lack Indonesian signatures and may originate from seeps in offshore basins along Australia's western and southern continental margins. The discovery of new oil families of non-Indonesian provenance in bitumens found on the South Australian coastline has important implications for the prospectivity of the Bight.

Researchers used oceanographic models to describe the source of observed strandings of tar balls and asphaltites,

The study proved the existence of hydrocarbons in the central deep-water Ceduna Sub-basin, and bitumen strandings provided evidence of hitherto unknown petroleum systems in the Great Australian Bight.

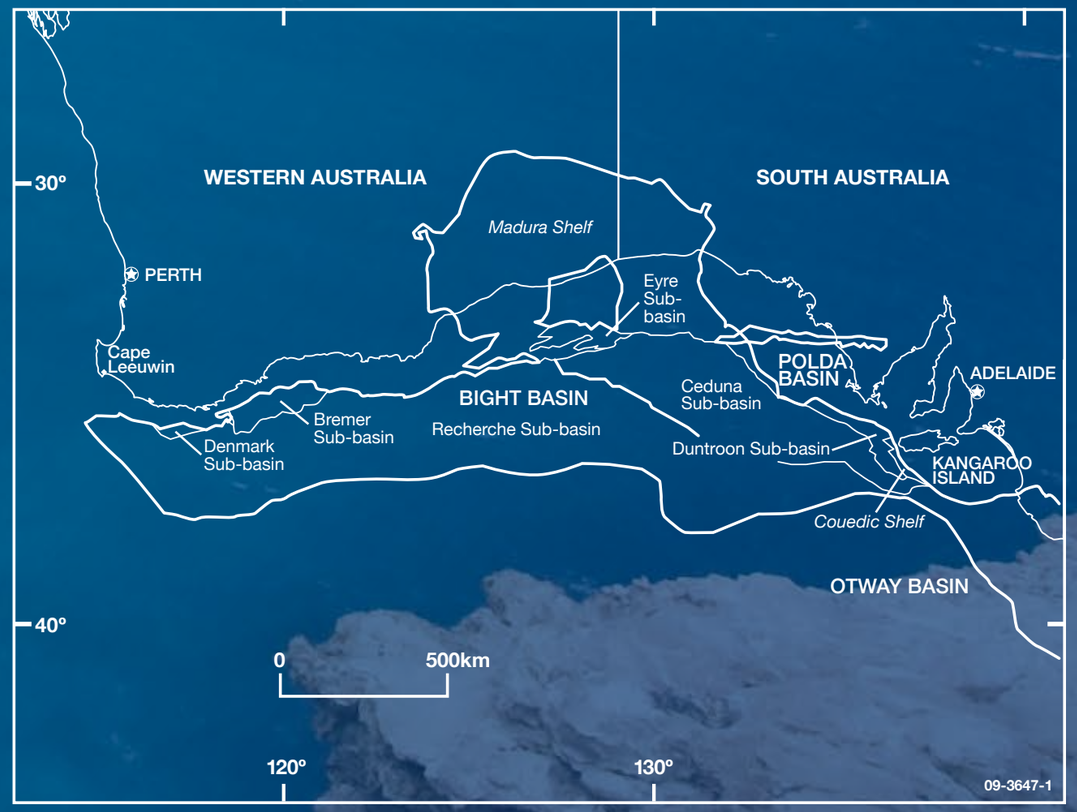
finding that winter conditions transport materials west to east and can supply materials to all beaches in the Great Australian Bight, consistent with the widespread discovery of Indonesian waxy bitumens. The most likely source of strandings on the Eyre Peninsula is located west of Kangaroo Island and overlies the Duntroon Sub-basin and eastern part of the Ceduna Sub-basin, where leakage may occur.

Hidden oil and gas, contained within fluid inclusions trapped in sand grains, has been used by researchers to trace migration, source and timing of petroleum in six offshore wells in the Bight Basin and provided geochemical analogues to assess the potential origin of coastal bitumen strandings.

Discovery of microscopic oil-bearing and gas-rich inclusions by the Grains with Oil Inclusions™ method implies that some rocks in the basin were capable of generating petroleum. Researchers geochemically fingerprinted this petroleum using the Molecular Composition of Inclusions method. They showed the organic matter was sourced not only from terrestrial plants but, for the first time, algae and Type II kerogen. Modelling the trapping conditions (pressure-temperature) indicates that petroleum migrated from the Late Cretaceous (~70-75 Ma) onwards in the deep Ceduna Sub-basin and was recorded at later times on the basin margin.

The combined studies of bitumen strandings and fluid inclusions has provided evidence of active, hitherto unknown petroleum systems in the Great Australian Bight and improves the exploration potential of the Bight Basin.

Below:
Location of the Bight Basin with component sub-basins.



Profiles of the economy
and community

The pristine marine environment was a key factor underlying many people's attachment to the region.

SOCIO-ECONOMIC ANALYSIS

Regional communities in the Eyre Peninsula and West Coast of South Australia could be affected by the development of a petroleum industry in the Great Australian Bight.

So an understanding of the nature, structure and capacity of these communities is needed to predict the impacts. Researchers in the GABRP's Socio-economic Analysis Theme undertook the first targeted socio-economic assessment of the Eyre Peninsula, and developed an economic model for the region that can be used in assessments of the economic impacts of future developments.

The region's population was 56,286 in 2011 (3.5 per cent of South Australia). Approximately 64 per cent of the region's population lived in the City of Whyalla (22,088) and City of Port Lincoln (14,086), while 635 people lived on the unincorporated west coast (not part of any local government area). Almost 83 per cent of the region's population was born in Australia; over 5.5 per cent (3162) identified as an Aboriginal person in the 2011 census. The Nauo (south western Eyre), Barngarla (eastern Eyre), Wirangu (north western Eyre), and Mirning (far western Eyre) are the Aboriginal Nations that were present when Europeans arrived, and they maintain traditional ties to Country in the study area.

The research provided a regional economic baseline, identifying the range and relative importance of different industries to employment, income and the processes currently driving development. The project developed a series of regional models for subsequent analysis of economic impacts.

Below:
A baseline of social and economic data of the Eyre Peninsula and West Coast region has been developed, against which future development and change can be assessed. Photo: Crystal Beckmann.

Above:
Commercial fishing continues to make a significant contribution to the economy of the Great Australian Bight.

The social baseline study identified that the region is characterised by a small and sparsely distributed population and highly dependent on primary industries (that is, agriculture, fishing and aquaculture). There is migration of younger residents to larger centres and Adelaide for employment and education. The population and workforce in the region are older than the rest of South Australia. There is a strong attachment to place in the region, with the pristine coastal and marine environment a key factor underlying this attachment. Attitudes to development were largely positive, with expectations of alternative employment opportunities generated directly (by the oil industry) and indirectly (through increased population in the region). Residents raised concerns about potential environmental damage.

Another project documented the socio-economic status of the regional communities and identified concerns about the development of an oil industry in the Eyre Peninsula and West Coast regions. The economic baseline study largely confirmed findings from the social survey, namely that primary industries were the dominant sectors for gross regional product and employment. Unemployment was lower than the State average, partly due to the migration from the region of those seeking employment. The economic study found that there was a skills shortage in the region, and that direct employment opportunities from an oil and gas development would result in an influx of workers. Infrastructure in the region was considered relatively poor by the community, and improvements in infrastructure as a result of any development would benefit existing industries.

A third project focused on the fisheries and aquaculture industries in the Great Australian Bight. The project determined the current economic status of the different fisheries and aquaculture businesses, including gross value of production, profitability and contributions to the regional economy. Researchers undertook a qualitative assessment of the potential impacts of development on the region's fisheries.

South Australia's fishing and aquaculture industries are important to the region's economy, generating 25 per cent of Australia's seafood by value. Total gross value of production has remained relatively constant over the past decade, ranging between $400 and $500 million per annum, but in real terms has declined by around one third. Most of the year-to-year variation occurs in aquaculture production, with the wild-caught fisheries being relatively stable in terms of gross value of production. Similarly, most of the reduction in gross value of production in real terms since 2000–01 has been in aquaculture, with a 50 per cent decline.

Above:
Developing a social understanding of communities across the Eyre Peninsula and West Coast region was critical in understanding how offshore oil and/or gas activities in the Great Australian Bight may affect these communities.

Most of the value from wild-caught fisheries comes from the South Australian State-managed fisheries. The aquaculture industry in inshore and coastal waters is largely based on ranching of juvenile southern bluefin tuna, initially taken from the Commonwealth fishery. The tuna ranching activity contributes around two thirds of the value of aquaculture production in South Australia. The Pacific Oyster industry has also developed into a major aquaculture industry, with South Australia now the major producer of Pacific Oysters in Australia.

The Theme's three projects identified a range of potential positive and negative impacts of the development of an oil and/or gas industry in the region. Lack of appropriate infrastructure was identified as a major constraint to development, with both social and economic consequences. Many people had expectations that the development of an oil industry would contribute to the improved development of infrastructure such as roads, rail, port facilities and airports. This in turn would have spin-off effects for tourism (through better access) and the exporting industries, as well as contributing to safety (through better roads) and better access to health services. Further, better airport infrastructure would facilitate the increase of fly-in-fly-out workers, with possible benefits to the local mining industry.

The expected range of alternative employment opportunities was seen as a positive. While it was recognised that much of the labour associated with development would most likely be specialised; the increase in population would increase the demand for support services. An influx of workers associated with the development of the oil industry would not only increase the population directly, but may also contribute to the retention of young people who may otherwise leave.

Concern was raised in the social baseline study about the potential environmental consequences of the proposed development, and the effect that this may have on fisheries (both commercial and recreational) and other marine life, particularly whales. Given the importance of ecotourism to the region, any environmental damage was considered to have potential negative economic consequences. From a fisheries and aquaculture perspective, the major threat was an oil spill. Qualitative modelling of different hypothetical oil spill scenarios suggested that coastal aquaculture was particularly at risk of an oil spill; albeit the likelihood of such a spill is low. Despite these environmental concerns, the regional communities were largely supportive of development.

Bringing it all together

Researchers evaluated the Great Australian Bight's vulnerability to climate change, fisheries, aquaculture and oil spills.

MODELLING AND INTEGRATION

The GABRP's Modelling and Integration Theme developed two ecosystem models, Ecopath with Ecosim (EwE) and Atlantis, to integrate disparate datasets (including old and new knowledge) and test hypothetical scenarios of development in the region. The two models will help future management of the Bight's socio-ecological systems.

Researchers used the models to evaluate the vulnerability of key species, food webs, habitats and animal groupings to potential ecosystem stressors, including climate change, fisheries, aquaculture and oil spills. They assessed the impacts of multiple stressors and identified socio-economic and ecological trade-offs associated with future multiple use of the Great Australian Bight.

The researchers in this theme also integrated work across the GABRP, establishing a whole-of-system understanding of the Bight to support future management of the region.

Ecopath describes the energy flow of an ecosystem at a point in time, while *Ecosim* forecasts ecosystem responses to environmental changes. Brought together as *EwE*, the simulation can evaluate trade-offs among fishing and aquaculture activities. The Great Australian Bight *EwE* model included seven types of mammals, eight birds, six chondrichthyans, 24 teleosts, two farmed finfish and shellfish, three cephalopods, 17 other invertebrates, two bacteria and microbes, four autotrophs, and one detritus. The model used dietary information, biomass, consumption per unit of biomass, production per unit of biomass, and ecotrophic efficiency to create the model.

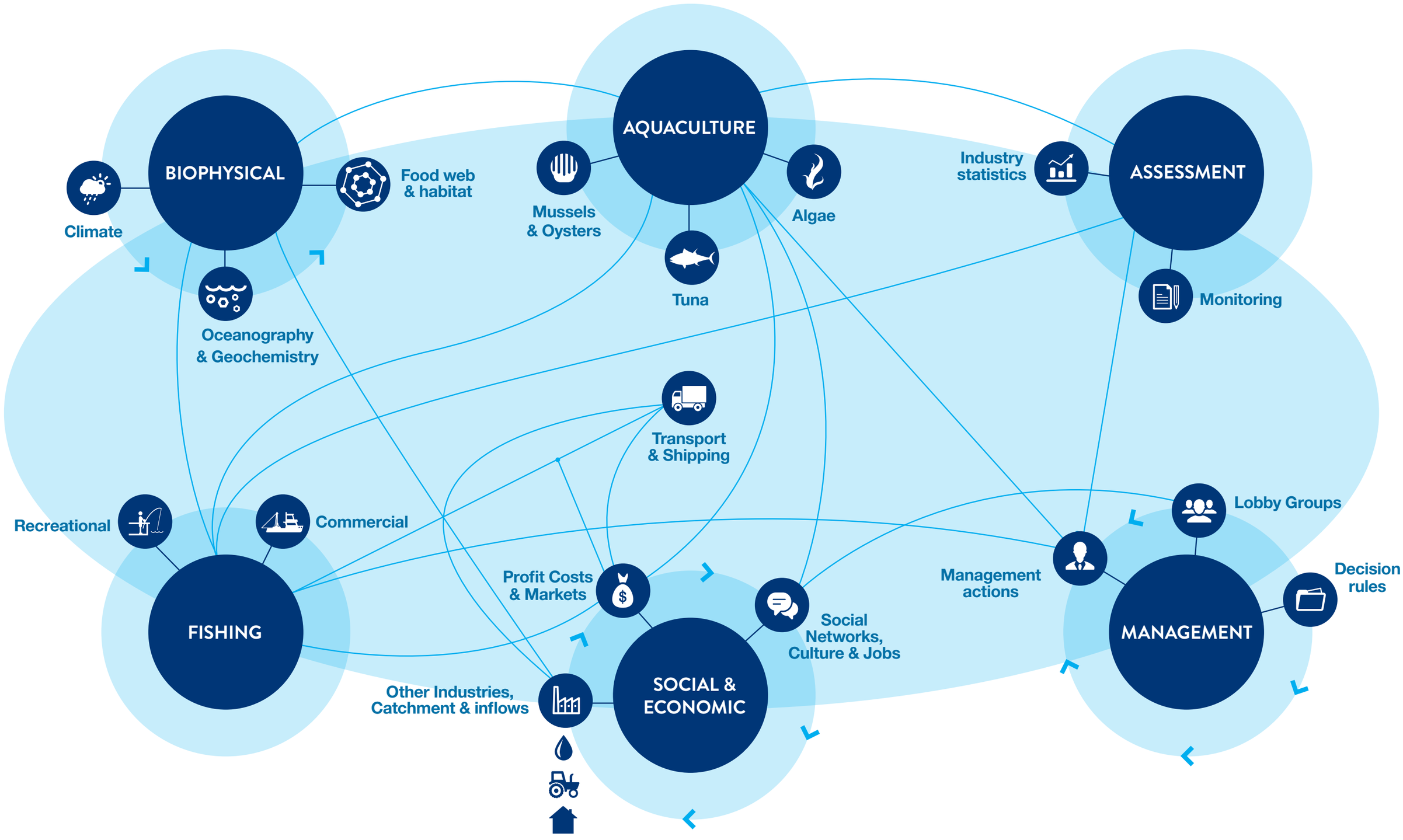
The whole-of-system, or end-to-end, model *Atlantis* is designed to support strategic assessments of the interactions among sectors and evaluation of the potential ecological, economic and social costs and benefits of development scenarios, including cumulative impacts. It incorporates oceanographic data and dynamics (e.g. temperature, salinity, and horizontal and vertical advection-diffusion) and 64 functional groups (each group aggregates species with similar size, diets, habitat preferences, migratory patterns, metabolic rates, and life history strategies), which represent the entire food web – inshore and offshore, pelagic and demersal, and from bacteria and phytoplankton up to top predators.

Both models also included fishing fleets. Researchers obtained annual fishery landings and effort data for the Bight from 2006–11 for 34 fishing fleets, and estimated discard rates from independent surveys. These data were then used to shape the form of the fisheries in the models and to see if the models could reproduce historical trajectories for the region. *Atlantis* also included a simple representation of recreational fishing, shipping, energy generation, ports and catchment use.

Researchers integrated data from across the GABRP into the two models (*EwE and Atlantis*) to simulate the Great Australian Bight ecosystem and examine the ecological consequences of hypothetical scenarios involving changes in temperature, fishing pressure, stock abundances, spatial management, or an accidental release of fuel along one of the Bight's major shipping routes. Scenarios of high fishing had the greatest negative impact on relative biomasses of individual functional groups, while scenarios of ocean warming had the largest impacts on the indicators of ecosystem structure and integrity. Oil spills caused by potential off-shore shipping accidents would have greatest impacts on seabirds, pelagic fishes and marine mammals, with flow on effects to the whole ecosystem, but only in a confined area immediately around the incident's footprint. The simulations allow whole-of-system management decisions to be tested in support of sustainable development.

ATLANTIS MODEL

A conceptual model that integrated knowledge of ecosystem processes and socio-economic values obtained in the Great Australian Bight Research Program.



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Althaus F, MacIntosh H, Williams A, Gowlett-Holmes K, Tanner J and Loo M (2017). Benthic invertebrate megafauna of the deep Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Baghurst B (2017). Seeking whole-of-system understanding: an integrated study of environmental, economic and social values. Australian Marine Sciences Association (AMSA) Launch, University of Adelaide, 12 September 2017.

Baghurst B, Lukatelich R, Smith D, Begg G, Lewis L and Smith R (2017). An integrated study of environmental, economic and social values. Australian Petroleum Production & Exploration Association (APPEA) Conference & Exhibition, Perth, May 2017.

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Bailleul F, Goldsworthy S, van Ruth P, Harcourt R and McMahon C (2015). Assessing the smallest by one of the biggest: Australian sea lions (Neophoca cinerea) as investigators of primary production in the Great Australian Bight. Australian Marine Science Association (AMSA) Conference 2015, Geelong, July 2015.

Begg G.A, Baghurst B, Lukatelich R, Smith D.C, Lewis R and Smith R (2017). The Great Australian Bight Research Program. Goyder Institute for Water Research Water Forum, Adelaide, July 2017.

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Catalano S, Yang Q, Wos-Oxley M, Sorokin S, Tanner J and Oxley A (2018). Microbiomics from the deep: exploring the microbial diversity of deep sea sponges from the Great Australian Bight. Australian Marine Science Association (AMSA), Adelaide, 1-5 July 2018.

Corrick A, Hall P, McKirdy D, Gong S, Trefry C, Dyt C, Angelini Z, Ross A, Kempton R, Armand S and White C (2016). A revised oil family classification scheme and geochemical weathering proxies for South Australian coastal bitumen strandings. 19th Australian Organic Geochemistry Conference, Fremantle, 4-7 December 2016.

Crowther A and Mitchell M (2018). First comprehensive study of the deep-sea anemones (Cnidaria: Actiniaria) from the Great Australian Bight: 2015 & 2017 surveys. Australian Marine Sciences Association (AMSA), Adelaide, 1-5 July 2018.

Davies B and James N (2015). The origin of temperate carbonate slope sediments: Eastern Great Australian Bight. The Inaugural Mountjoy Meeting, Advances in Characterisation & Modelling of Complex Carbonate Reservoirs, The Banff Centre, Banff, Alberta, 23-28 August 2015 (poster presentation).

Doubell M, Middleton J, van Ruth P, Kloser R and Spencer D (2017). Contrasting water column structure and mixing processes across the Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Evans K and Davies C (2014). Understanding the impacts of noise on juvenile southern bluefin tuna in the Great Australian Bight. Portland Upwelling Festival, Portland, 1 November 2014.

Evans K, Patterson T, Eveson P and Davies C (2014). Multi-decadal variability in the spatial dynamics of juvenile southern bluefin tuna. 5th Bio-logging Science Symposium, Strasbourg, France, 22-27 September 2014 (poster presentation).

Evans K, Patterson T, Eveson P, Davies C, Lansdell M, Hobday A and Cooper S (2016). Multi-decadal variability in the spatial dynamics of juvenile southern bluefin tuna. The 4th International Conference on The Effects of Noise on Aquatic Life, Dublin, Ireland, 10-16 July 2016 (poster presentation).

Everson P, Patterson T, Hartog J and Evans K (2017). Surfacing rates of juvenile southern bluefin tuna in the Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Fulton B, Smith D, Bulman C and Goldsworthy S (2018). Navigating the Great Australian Bight using system models. Australian Petroleum Production & Exploration Association (AAPEA) 2018, May 2018, Adelaide.

Gershwin L (2016). The trouble with jellyfish. Keynote address to the National Academies of Science, USA. The Deep Blue Sea: NAS/Keck Futures Initiative, Irvine, California, USA, 9 November 2016.

Gershwin L, Kloser R, Sutton C, Flynn A, Downie R, Ryan T (2017). Siphonophores: fearsome predators in oceanic food webs. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Goldsworthy S, Middleton J, van Ruth P, Leterme S and Lapidge S (2015). SAIMOS – South Australian Integrated Marine Observing System. IMOS planning meeting, Melbourne, Australia, 17 & 18 February 2015.

Griffin D, Hammer M, Hertzfeld M, James C and Oke P (2017). Circulation of the Great Australian Bight: the influence of waves and the Leeuwin Current. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Griffin D, Hemer M, James C and Herzfeld M (2016). 'What do we mean by "Surface Current'?' Australian Coastal Ocean Modelling and Observations (ACOMO) workshop, Canberra, 11-12 October 2016.

Kempton R, Bourdet J, Gong S, Ross A and Pironon J (2016). Petroleum migration in the Bight Basin: a fluid inclusion approach to constraining source, composition and timing. Australian Earth Sciences Convention (AESC), Adelaide, 26-30 June 2016.

Kempton R, Bourdet J, Gong S, Ross A and Pironon J (2017). Petroleum migration in the Bight Basin: a fluid inclusion approach to constraining source, composition and timing. Australian Petroleum Production & Exploration Association (APPEA), Conference & Exhibition, Perth, 14-17 May 2017.

Kempton R, Bourdet J, Gong S, Ross A and Pironon J (2017). Petroleum migration in the Bight Basin: a fluid inclusion approach to constraining source, composition and timing. Internal presentation to Origin Energy, Brisbane, 3-6 July 2017.

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Kloser R, Ryan T and Downie R (2017). Exploring the slope/offshore Great Australian Bight (GAB) pelagic habitat paradox with bioacoustics. International Council for the Exploration of the Sea (ICES) Working Group on Fisheries Acoustics Science and Technology meeting, Nelson, New Zealand, 5-7 April 2017.

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Kloser R, van Ruth P, Doubell M, Richardson A and Revill A (2017). Exploring the slope/offshore Great Australian Bight (GAB) pelagic habitat paradox. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

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Langhi L (2015). Fault-related biogenic mounds: implications for hydrocarbon migration in the Ceduna Sub-basin. American Association of Petroleum Geologists (AAPG) - Society of Exploration Geophysicists (SEG) International Conference & Exhibition 2015, Melbourne, 13-16 September 2015.

Langhi L, Strand J and Ross A (2017). 3D stratigraphic and fault seal modelling: migration and trapping in the Great Australian Bight. American Association of Petroleum Geologists (AAPG) ICE, 15th – 18th October 2017, London.

Lapidge S (2016). A case study in collaborative research with industry. National Marine Science Committee meeting, Canberra, April 2016.

Lee K, Smith D and Ross A (2014). CSIRO R&D activities to address environmental issues related to offshore oil and gas development. Australian Petroleum Production & Exploration Association (APPEA) Conference & Exhibition, Perth, April 4-6 2014.

Lewis A (2015). Diversity in the deep: systematics, phylogenetics and biogeography of deep-sea isopods and amphipods. PhD presentations, University of Adelaide, September 2015.

Lewis A, Austin A, Guzik M, King R and Tanner J (2016). Diversity in the Deep: systematics, phylogenetics and biogeography of deep-sea crustaceans from the Great Australian Bight. University PhD Symposium, University of Adelaide, July 2016.

Lewis A, Austin A, Guzik M, King R and Tanner J (2017). Diversity in the deep-sea: uncovering the diversity of deep-sea crustaceans. Systematics 2017: integrating systematics for conservation and ecology, Adelaide, 26-29 November 2017.

McKirdy D, Corrick A, Ross A, Gong A, Trefry C, Dyt C, Angelini Z, Jobin O, Hall A, Edwards D (2015). Understanding the geographical distribution of historical and modern asphaltite strandings along the South Australian coastline. American Association of Petroleum Geologists (AAPG) - Society of Exploration Geophysicists (SEG) International Conference & Exhibition 2015, Melbourne, 13-16 September 2015.

Middleton J and Griffin D (2015). Oceanography: the science that underpins. Australian Coastal Ocean Modelling and Observations (ACOMO) Workshop, Canberra, 7 & 8 October 2014.

Middleton J and Luick J (2017). Circulation and dynamics of the Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Middleton J, Griffin D, Luick J and Hertzfeld M (2016). Ocean modelling of the Great Australian Bight. National Australian Coastal Ocean Modelling and Observations (ACOMO) workshop, Shine Dome in Canberra, 11-12 October 2016.

Patten N and van Ruth P (2015). Picoplankton community structure and virioplankton abundance in offshore waters of the central Great Australian Bight. Australian Marine Sciences Association Conference, AMSA 2015, Geelong, July 2015.

Patten N and van Ruth P (2016). Environmental drive shifts in plankton and viral community composition in slope and offshore waters of the Great Australian Bight (southern Australia). Theo Murphy Australian Frontiers of Science; The Microbiome – Exploring the role of microorganisms in ecosystem processes and health, Adelaide, November 29-December 1 2016.

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Patten N, van Ruth P, Richardson A and Redondo-Rodriguez A (2018). Scenario driven shifts in upwelling and downwelling drive food web dynamics in the eastern Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference, Adelaide, 1-5 July 2018.

Patterson T, Everson P, Hartog J, Evans K, Lansdell M, Cooper S, Hobday A and Davies C (2017). Cyclical migration dynamics in juvenile southern bluefin tuna. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

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Conference abstracts and presentations

Patterson T, Eveson P, Hartog J, Evans K, Hobday A and Davies C (2015). Quantifying migration dynamics in juvenile southern bluefin tuna (Thunnus maccoyii). 3rd CLIOTOP Symposium, San Sebastián, Spain, 14-18 September 2015.

Revill A, Kloser R and Sutton C (2018). Differentiating drivers of pelagic food webs in the central and eastern Great Australian Bight using compound specific amino acid nitrogen isotopes. Australasian Environmental Isotope Conference (AEIC), Wellington, New Zealand, 26-28 March 2018.

Rogers P (2015). Pelagic shark research: an overview of SARDI projects. SARDI Seminar Series, SARDI Aquatic Sciences, Adelaide, 29 October 2015.

Rogers P and Drew M (2016). Pelagic shark research: an overview of SARDI projects. Natural Resource Management (NRM) Science Conference – Sharing Science for Better Outcomes, Adelaide, 13-15 April 2016.

Sherlock M, Marouchos A and Williams A (2014). An Instrumented Corer Platform for Seabed Sampling and Water Column Characterisation. IEEE Oceanic Engineering Society (OES) and Marine Technology Society (MTS) conference, Oceans'14, Taipei, Taiwan, April 7-10 2014.

Sorokin S and Goudie L (2017). Dominance and diversity of deep-water sponges on the shelf edge and slope of the Great Australian Bight, South Australia. World Sponge Conference, National University of Ireland, Galway, June 25-30 2017.

Sorokin S, Klautau M, Goudie L, Crowther A, Fromont J, George AM, McCormack S and Wahab MAA (2017). Calcarea on the shelf edge of the Great Australian Bight, Australia. World Sponge Conference, National University of Ireland, Galway, June 25-30 2017.

Strand J, Langhi L and Ross A (2015). Predictive stratigraphic forward modelling of the Ceduna Sub-basin; application to fault sealing. American Association of Petroleum Geologists International; Meeting 2015; 13-16 September 2015 (poster presentation).

Sutton C, Flynn A and Kloser R (2017). Micronekton in the Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Tanner J, Althaus F, Sorokin S and Williams A (2017). Biogeography of southern Australian deep sea fauna. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Tanner J, Althaus F, Sorokin S, MacIntosh H, Gowlett-Holmes K and Williams A (2017). Infaunal assemblage structure in the deep GAB. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Van de Kamp, Hook J, Williams A, Tanner J and Bodrossy L (2016). Diverse hydrocarbon degrading microbial communities in a pristine ocean basin, Poster for 16th International Symposium of Microbial Ecology, 21-26 August 2016, Montreal, Canada (poster).

Van de Kamp, Hook S, Tanner J, Williams A and Bodrossy L (2017). Diversity and abundance of microbial hydrocarbon degradation pathways in the offshore environments of the Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Van Ruth, P. D. (2014) Lower trophic ecosystem dynamics in southern Australian waters: known knowns and known unknowns in the SAIMOS node region. Deakin University, June 2014, Warrnambool, Victoria.

Van Ruth, P., Huveneers, C. (2016) The Southern Australian Integrated Marine Observing System – Strengths, weaknesses, opportunities, threats. IMOS National Planning Meeting, March 2016, Hobart, Tasmania.

Van Ruth P, Patten N, Doubell M, Chapman P, Redondo-Rodriguez A and Middleton J (2018). Seasonal- and event-scale variations in the influence of upwelling on enrichment and primary productivity in the eastern Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference 2018, Adelaide, 1-5 July 2018.

Van Ruth P, Patten N and Redondo A (2017). Variations in productivity in the Great Australian Bight: uncovering hidden influences on the food web, Conference PEP talk. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Verma A (2016). Passive Acoustic Monitors, Listening to the Soundscape. Curtin Marine and Coastal Research Network Conference, Perth, 18 February 2016.

Verma A (2016). Passive Acoustic Monitors, Listening to the Soundscape. Marine and Coastal Research Network Conference, Curtin University, 18 February 2016.

Verma A (2016). Ping to ping variations in the frequency dependent target strength of single targets using broadband echosounder (EK80), International Council for the Exploration of the Sea (ICES) Working Group on Fisheries and Acoustic Science and Technology, Vigo Spain, April 19-22 2016.

Verma A, Duncan A and Kloser R (2016). Developing active broadband acoustic methods to investigate the pelagic zone of the Great Australian Bight, The 2nd Australasian Acoustical Societies' Conference, ACOUSTICS 2016, Brisbane, 9-11 November 2016.

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Conference abstracts and presentations

Verma A, Duncan A and Kloser R (2016). Development of wideband acoustic classification techniques for mesopelagic micronektons. Australian Acoustic Society WA Division 2016 State Seminar and AGM, Perth, 7 October 2016.

Verma A, Duncan A and Kloser R (2016). Ping to ping variations in the frequency dependent target strength of single targets using a broadband echosounder (EK80), Working Group abstract, ICES Working Group on Fisheries Acoustics Science and Technology meeting in Vigo, Spain, April 19-22 2016.

Verma A, Duncan A and Kloser R (2017). Calibration of broadband sonars operating at depth. International Council for the Exploration of the Sea (ICES) Working Group on Fisheries Acoustics Science and Technology meeting, Nelson, New Zealand, 5-7 April 2017.

Verma A (2016). Developing active broadband acoustic methods to investigate the pelagic zone of the Great Australian Bight. 2nd Australasian Acoustical Societies Conference, ACOUSTICS 2016, Brisbane, 9-11 November 2016.

Ward T (2013). A new partnership for a new whole of ecosystem initiative. Joint Australian Society of Fish Biology conference (ASFB), New Zealand Freshwater Sciences Society (NZFSS), and New Zealand Marine Sciences Society (NZMSS), Hamilton, New Zealand, 19-23 August 2013.

Ward T (2013). A new partnership for a new whole of ecosystem initiative. Presentation to the BP Science Network at the Harte Research Institute, Houston, USA, July 2013.

Ward T (2013). AMSA and MISA played an important role in establishing the GAB Research Program - what roles can they play in the future. South Australian division of the Australian Marine Sciences Association (AMSA) Conference, Adelaide, 2013.

Ward T, Begg G, Smith D and Lukatelich R (2014). Benefits of establishing ecological and socio-economic baselines during the exploration phase: case study in the Great Australian Bight. Australian Petroleum Production & Exploration Association (APPEA) Conference & Exhibition, Perth, April 4-6 2014.

Ward T, Middleton J, Griffin D, Kloser R, van Ruth P, Goldsworthy S, Davies C, Williams A, Tanner J, Ross A, Kempton R, Fulton B and Bulman C (2017). Synthesis and Integration. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Ward T, Smith D, Lukatelich R, Lewis R, Begg G and Smith R (2014). Integrated approach to ecological and socio-economic research to support the oil and gas industry: the Great Australian Bight Collaborative Research Science Program. International Oil Spill Conference (IOSC) 2014, Savannah, Georgia, USA, May 5-8 2014.

Whiltshire K, Tanner J, Althaus F, Sorokin S and Williams A (2018). Predicting environmental suitability for key benthic taxa in an ecologically and economically important deep-sea environment. Australian Marine Sciences Association (AMSA) Conference. Adelaide, 1 – 5th July 2018.

Williams A, Graham K, Gomon M, Bray D, McMillian P, Pognoski J, Appleyard S, Gledhill D, Doyle S, Graham A, Osterhage D and Althaus F (2017). The deepest systematic collection of benthic fishes in Australian waters – continental slope and rise of the Great Australian Bight. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Wiltshire K, Tanner J, Sorokin S and Althaus F (2017). Assessing environmental suitability of the GAB region for key deep-sea benthic taxa using species distribution modelling. Australian Marine Sciences Association (AMSA) Conference 2017, Darwin, 2-6 July 2017.

Community engagement

Great Australian Bight Research Program Stakeholder Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Beer A (2015). Project 6.1: Socio profile of the Eyre and western region: literature review and community analysis. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Corrick A (2015). The origin of coastal bitumen strandings in South Australia. Three minute thesis. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Davies C, Cooper S, Evans K, Eveson P, Hobday A, Landell M and Patterson T (2015). Southern bluefin tuna spatial dynamics and potential impacts of noise. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Goldsworthy S and Davies C (2015). Theme 4: Ecology of Iconic Species and Apex Predators. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Griffin D (2015). Surface waves: effects on circulation. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Kempton R (2015). Project 5.3: Fluid Inclusions. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Kloser R (2015). Characterise seasonal and spatial variability of offshore/slope plankton, and micronekton communities. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

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Community engagement

Kloser R and van Ruth P (2015). Theme 2: Physical ecosystem and environmental drivers. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Lapidge S (2015). A new partnership for a new whole of ecosystem initiative. Great Australian Bight Research Program Science Symposium, Adelaide, 19 August 2015.

Lewis A (2015). Diversity in the deep: systematics, phylogenetics and biogeography of deep-sea isopods and amphipods. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015 (3 minute thesis).

Middleton J, Luick J, Griffin D (2015). Physical Oceanography: the science that underpins. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Pascoe S and Innes J (2015). Project 6.3 Great Australian Bight fisheries benchmark study. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Ross A (2015). Project 5.1: Hydrocarbon seeps. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Ross A (2015). Project 5.2: Asphaltites and tarballs. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Van Ruth P and Kloser R (2015). Theme 2: Pelagic ecosystem and environmental drivers. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Verma A (2015). How many fish? Three minute thesis. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Ward T, Fulton B, Goldsworthy S, Bulman C and Loo M (2015). Knowledge integration of the socio-ecological systems of the Great Australian Bight. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Whetton S and Young M (2015). Regional Economic Baseline and Model. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Williams A and Tanner J (2015). Benthic biodiversity: projects 3.1 and 3.2. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 19 August 2015.

Great Australian Bight Research Program Stakeholder Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Baghurst B (2017). Seeking whole-of-system understanding: an integrated study of environmental, economic and social values. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Beer A and Thredgold C (2017). Project 6.1: Social profile of the Eyre and Western region: literature review and community analysis. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Davies C, Patterson T, Eveson P, Hartog J, Hobday A, Cooper S and Lansdell M (2017). SBT spatial dynamics and potential impacts of noise. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Goldsworthy S, Bailleul F and Patterson T (2017). Project 4.2 Identifying areas of ecological significance for iconic species and apex predators in the GAB. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Goldsworthy S, Bulman C and Rogers P (2017). Project 7.1 Knowledge integration of socio-ecological systems of the GAB: a trophodynamic model of the GAB ecosystem (Ecopath). Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Goldsworthy S, MacKay A, Rogers P, Moller L, Parra G and Gill P (2017). Project 4.1, Status, distribution and abundance of iconic species and apex predators in the GAB. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Griffin D, Hemer M, Herzfeld M, James C and Oke P (2017). Circulation of the Great Australian Bight: the influence of waves and the Leewin Current. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Kempton R, Bourdet J and Gong S (2017). Project 5.3: Fluid inclusions. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Middleton J and Griffin D (2017). Oceanography: the science that underpins. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Pascoe S and Innes J (2017). Project 6.3 GAB fisheries benchmark study and potential impacts of the development. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

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Ross A, Corrick A, Trefry C, Gong S, McKirdy D, Hall T, Dyt C, Angelini Z, Armand S, Kempton R, Picard A, White C, Maslin S, Tucker L, Margot S, Jobin O (2017). Project 5.2: Asphaltites and tarballs. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Ross A, Langhi L, Talukder A, Trefry C, Stalvies C, Gong S, Strand J, Ahmed M, Crooke E, Qi X and Gresham M (2017). Project 5.1: Hydrocarbon seeps. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Tanner J (2017). Benthic biodiversity: project 3.2. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Van Ruth, Patten N, Doubell M and Redondo Rodriguez A (2017). Lower trophic ecosystem dynamics in the Great Australian Bight. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Ward T, Middleton J, Griffin D, Kloser R, van Ruth P, Goldsworthy S, Davies C, Williams A, Tanner J, Ross A, Young M, Beer A, Pascoe S, Kempton R, Fulton B and Bulman C (2017). Key findings, outputs and legacy. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Whetton S (2017). Regional Economic Baseline, Economic Modelling and Scenario Testing. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Williams A (2017). Benthic biodiversity: project 3.1. Great Australian Bight Research Program Science Symposium, SARDI Aquatic Sciences, Adelaide, 9 August 2017.

Industry meetings

Begg G (2016). A case study in collaborative research with industry. Australian Southern Bluefin Tuna Industry Association (ASBTIA) Industry Workshop, Port Lincoln, 15 November 2016.

Evans K (2014). Southern bluefin tuna: spatial dynamics and potential impacts of noise. Australian Southern Bluefin Tuna Industry Association (ASBTIA) Industry Workshop, Port Lincoln, Australia, 27 November 2014.

Evans K, Davies C, Patterson T, Eveson P, Hobday A, Lansdell M, Bradford R and Cooper S (2015). Southern bluefin tuna: spatial dynamics and potential impacts of noise associated with oil and gas exploration. Australian Southern Bluefin Tuna Industry Association (ASBTIA) Science Workshop, Port Lincoln, 12 November 2015.

Evans K, Patterson T, Eveson P, Hartog J, Hobday A, Cooper S, Landsdell M and Davies C (2016). Southern bluefin tuna: spatial dynamics and potential impacts of noise. Australian Southern Bluefin Tuna Industry Association (ASBTIA) Industry Workshop, Port Lincoln, 15 November 2016.

Community presentations and events

Baghurst B (2017). A case study in collaborative research with industry. Presentation to Marine Innovation Southern Australia (MISA). SARDI Aquatic Sciences, Adelaide, 17 March 2017.

Bailleul F (2015). In the eyes of the lion… Looking at behaviour and habitat of Australian Sea Lions and other iconic marine predators in the GAB region. SARDI Seminar Series, SARDI Aquatic Sciences, Adelaide, May 2015.

Begg G, Baghurst B, Lukatelich R, Smith D, Lewis R and Smith R (2017). The Great Australian Bight Research Program. Goyder Water Forum, Adelaide, 4 July 2017.

Great Australian Bight Research Program exhibit (2015), Science Alive 2015, 10th Anniversary of Science Alive – All kinds of awesome, Adelaide, South Australia, 8 & 9 August 2015.

Great Australian Bight Research Program exhibit (2017), SARDI Aquatic Sciences Open Day, Adelaide, South Australia, 19 November 2017.

Lapidge S (2015). A new partnership for a new whole of ecosystem initiative. Great Australian Bight Research Program. Presentation to Marine Innovation Southern Australia (MISA), SARDI Aquatic Sciences, Adelaide, October 2015.

Lapidge S (2016). A case study in collaborative research with industry. Presentation to Marine Innovation Southern Australia (MISA). SARDI Aquatic Sciences, Adelaide, September 2016.

Lewis A (2015). Diversity in the deep: systematics, phylogenetics and biogeography of deep-sea isopods and amphipods from the Great Australian Bight, SARDI Student Symposium, SARDI Aquatic Sciences, Adelaide, 2015.

PUBLICATIONS

Community engagement

Patten N and van Ruth (2015). Picoplankton and virioplankton in offshore waters of the Great Australian Bight; Nicole Patten (SARDI); SARDI Seminar Series, SARDI Aquatic Sciences, Adelaide, 2015.

Redondo Rodriguez A (2015). Satellite Data – Access, Uses and Limitations, South Australian Research and Development Institute (SARDI) Seminar Series, Adelaide, 2015.

Industry publications

A wave of knowledge from deep in the Bight, Issue 237: Great Australian Bight feature, CSIRO publication, https://blogs.csiro.au/ecos/category/2017/issue-237-great-australian-bight/

Great Australian Bight Research Program, The Australian Oil & Gas Review; June 2015, pp. 10-11

More than a mouthful, Issue 02, Resourcing SA Autumn, 2016, P. 08.

New Discoveries in the Bight, Issue 05, Resourcing SA Summer 2016, pp. 24-25.

Playing tag with tuna in the Bight, Issue 237: Great Australian Bight feature, ECOS, CSIRO publication, https://blogs.csiro.au/ecos/category/2017/issue-237-great-australian-bight/

SBT research,TARFish Bulletin January 2015, http://www.tarfish.org/bulletins/TARFishBulletin201501.pdf

Tracking the predators of the Bight, Issue 237: Great Australian Bight feature, ECOS, CSIRO publication, https://blogs.csiro.au/ecos/category/2017/issue-237-great-australian-bight/

MODELS DEVELOPED FOR THE GABRP

Theme 1 - Oceanography

Hydrodynamic models for the Great Australian Bight using:

- ROMS (Regional Ocean Modelling System); and
- SHOC (Sparse Hydrodynamic Ocean Code)

The Great Australian Bight component of the Bluelink Global Ocean Model.

Wave models for the Great Australian Bight using:

- SWAN (Simulating Waves Nearshore)
- NOAA WaveWatch III

Theme 2 – Open Water Research

Conceptual models of lower trophic ecosystem dynamics.

Theme 3 – Sea-floor biodiversity

Benthic species distribution models for the Great Australian Bight.

Theme 4 – Apex predators

Distribution and habitat models of apex predators and iconic species in the Great Australian Bight.

Adapted generalised additive models and hidden Markov models to investigate southern bluefin tuna movement and behaviour.

Theme 5 – Petroleum systems

Oceanographic modelling of asphaltite and tarball strandings in the Great Australian Bight using:

- The Bluelink ReANalysis (BRAN2015), CSIRO global model, Forward tracks
- BRAN2015 Backtracks

Theme 6 – Socio-economic analysis

A Computable General Equilibrium (CGE) model of the Eyre Peninsula.

Bayesian Belief Network (BBN) Model (developed in Netica) adapted for the Great Australian Bight to assess the potential fisheries impacts of an oil spill.

Theme 7 – Integration and modelling

Ecosystem model for the Great Australian Bight using Ecopath with Ecosim.

Whole-of-system model for the Great Australian Bight using Atlantis.

Conceptual models of the Great Australian Bight system connections.

AWARDS

Great Australian Bight Research Program

Finalist in the 2017 South Australian Science Excellence Awards, Excellence in Research Collaboration.

Great Australian Bight Research Program Team

Winner SARDI Achievement Awards 2017, Delivery to Industry.

The Great Australian Bight Research Program

Winner PIRSA Achievement Awards 2018, Excellence in Fostering Industry Capability.

PARTNERS

The Great Australian Bight Research Program is a collaboration between BP, CSIRO, the South Australian Research and Development Institute (SARDI), the University of Adelaide, and Flinders University. The Program aims to provide a whole-of-system understanding of the environmental, economic and social values of the region; providing an information source for all to use.

PARTICIPANTS

Research Office

Ben Baghurst, Research Director; **Jane Ham,** Senior Research Officer, SARDI; **Steve Lapidge,** previous Research Director; **Tim Ward,** previous Research Director.

Management Committee

Rod Lukatelich, BP, Chair; **Rochelle Smith,** BP; **David Smith**, CSIRO; **Phillipa Ormandy,** CSIRO; **Gavin Begg,** SARDI; **Tim Anson,** University of Adelaide; **Rob Lewis,** Flinders University.

Independent Science Panel

Ian Poiner, Chair; **Richard Brinkman; Malcolm Clark; Robert Harcourt; Sarah Jennings; Peter McCabe; Iain Suthers.**

BP Subject Matter Experts

Arden Ahnell; Peter Evans; Lawrence Gill; Colin Grant; Lisa Hawke; Dave Hedgeland; Gayle Hough; Oliver Jones; Maarten Kuijper; Phil Middleton; Paul Page; Oliver Pelz; Cynthia Pyc; Sam Walker; Anne Walls; Sarah Wilford; Elizabeth Wild; Andrew Witt.

Core Staff

Oceanography

John Middleton, SARDI (Theme Co Leader); **David Griffin,** CSIRO (Theme Co-Leader); **Mark Doubell,** SARDI; **Mark Hemer,** CSIRO; **Mike Herzfeld,** CSIRO; **Charles James,** SARDI; **John Luick,** SARDI; **Peter Oke,** CSIRO

Pelagic Ecosystem and Environmental Drivers

Rudy Kloser, CSIRO (Theme Co-Leader); **Paul van Ruth,** SARDI (Theme Co-Leader); **Fred Bailleul,** SARDI; **Mark Doubell,** SARDI; **Ryan Downie,** CSIRO; **Adrian Flynn,** CSIRO; **Lisa-ann Gershwin,** CSIRO; **Rick McGarvey,** SARDI; **Nicole Patten,** SARDI; **Ana Redondo-Rodriguez,** SARDI; **Andy Revill,** CSIRO; **Anthony Richardson,** CSIRO; **Tim Ryan,** CSIRO; **Matt Sherlock,** CSIRO; **Caroline Sutton,** CSIRO; **Arti Verma,** Curtin University; **Tim Ward,** SARDI.

Bethic Biodiversity

Alan Williams, CSIRO (Theme Co-Leader); **Jason Tanner,** SARDI (Theme Co-Leader); **Franziska Althaus,** CSIRO; **Luciano Beheragaray,** Flinders University; **Lev Bodrossy,** CSIRO; **Pamela Brodie,** CSIRO; **Anthony Chariton,** CSIRO; **Nick Ellis,** CSIRO; **Karen Gowlett-Holmes,** CSIRO; **Mark Green,** CSIRO; **Paul Greenfield,** CSIRO; **Sharon Hook,** CSIRO; **Amelia Lewis,** University of Adelaide; **Mark Lewis,** CSIRO; **Maylene Loo,** SARDI; **Leo Mantilla,** SARDI; **Andrew Oxley,** SARDI; **Shirley Sorokin,** SARDI; **Sarah Stephenson,** CSIRO; **Minami Sasaki,** Flinders University; **Jodie van de Kamp,** CSIRO.

Ecology of Iconic Species and Apex Predators

Simon Goldsworthy, SARDI (Theme Co-Leader); **Campbell Davies,** CSIRO (Theme Co-Leader); **Fred Bailleul,** SARDI; **Scott Cooper,** CSIRO; **Karen Evans,** CSIRO; **Paige Eveson,** CSIRO; **Alistair Hobday,** CSIRO; **Matt Lansdell,** CSIRO; **Alice Mackay,** SARDI; **Luciana Moller,** Flinders University; **Guido Parra,** Flinders University; **Toby Patterson,** CSIRO; **Paul Rogers,** SARDI

Petroleum Geology and Geochemistry

Andrew Ross, CSIRO (Theme Co-Leader); **Richard Kempton,** CSIRO (Theme Co Leader); **Manzur Ahmed,** CSIRO; **Julien Bourdet,** CSIRO; **Alex Corrick,** University of Adelaide; **Emma Crooke,** CSIRO; **Chris Dyt,** CSIRO; **Se Gong,** CSIRO; **Mike Gresham,** CSIRO; **Laurent Langhi,** CSIRO; **Stacey Maslin,** CSIRO; **David McKirdy**, University of Adelaide; **April Picard,** CSIRO; **Charlotte Stalvies,** CSIRO; **Julian Strand,** CSIRO; **Asrar Talukder,** CSIRO; **Christine Trefry,** CSIRO; **Xiubin Qi,** CSIRO; **Cameron White,** CSIRO.

Socio-economic Baseline

Sean Pascoe, CSIRO (Theme Leader); **Andrew Beer,** University of Adelaide (Theme Co-Leader); **Mike Young,** University of Adelaide (Theme Co-Leader); **Suraya Abdul Halim,** University of Adelaide; **James Innes,** CSIRO; **Michael O'Neil,** University of Adelaide; **Chris Paris,** University of Adelaide; **Gertrude Szili,** University of Adelaide; **Charmaine Thredgold,** University of Adelaide.

Conceptual Ecosystem Model Development

Tim Ward, SARDI (Theme Co-Leader); **Beth Fulton,** CSIRO (Theme Co-Leader); **Simon Goldsworthy,** SARDI (Theme Co-Leader); **Catherine Bulman,** CSIRO; **Rebecca Gorton,** CSIRO; **Heidi Pethybridge,** CSIRO; **Paul Rogers,** SARDI.

PhD Students

Alex Corrick, University of Adelaide (**Supervisors: Tony Hall,** University of Adelaide; and **David McKirdy,** University of Adelaide; **Andy Ross,** CSIRO); **Amelia Lewis,** University of Adelaide (**Supervisors: Andy Austin,** University of Adelaide; **Rachael King,** SA Museum; **Michelle Guzik,** University of Adelaide; **Jason Tanner,** SARDI); **Arti Verma,** Curtin University (**Supervisors: Alec Duncan,** Curtin University; **Rudy Kloser,** CSIRO).

Other Participants

Major

Blue Whale Study Ltd Pty
Integrated Marine Observing System
Marine National Facility
Museum Victoria

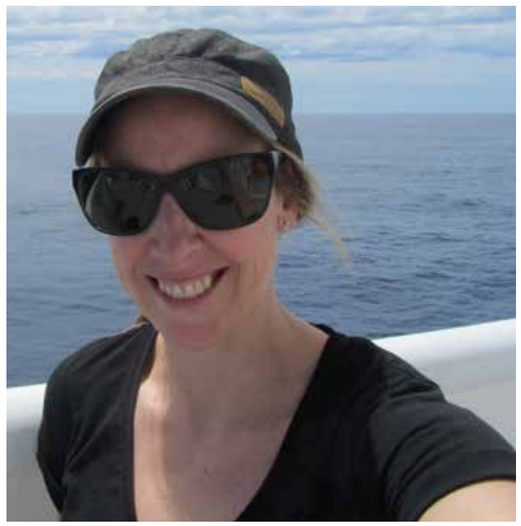
Minor

Australian Institute of Marine Science
Australian Museum
Centre de Recherches sur la Geologie des Matieres Premieres Minerales et Energetiques (CREGU)
Curtin University
Griffith University
Lisa Goudie consultancy
Macquarie University
National Museum of Natural History, Smithsonian Institution, USA
New-Fathom Pacific Pty Ltd
Queensland Museum
South Australian Museum
Texas A&M University, USA
Universidade Federal do Rio de Janeiro, Brazil
University of Lodz, Poland
University of New South Wales
University of Tasmania
University of Technology Sydney











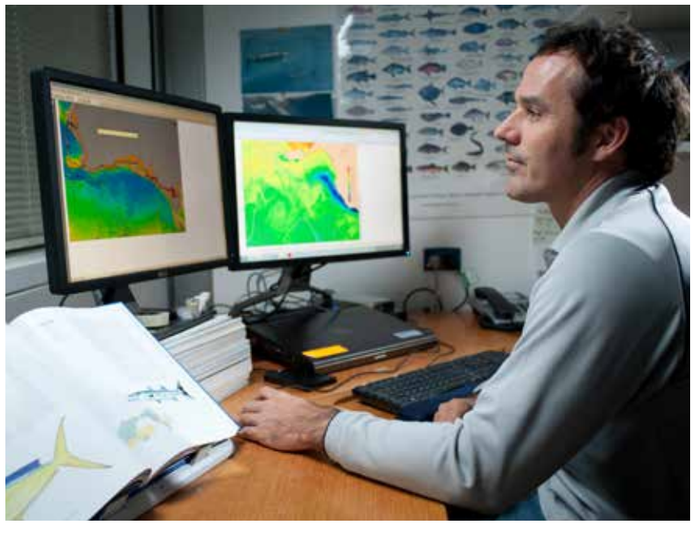




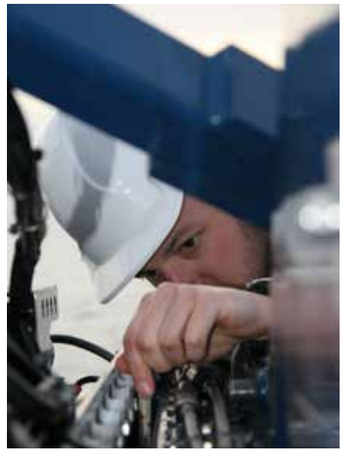


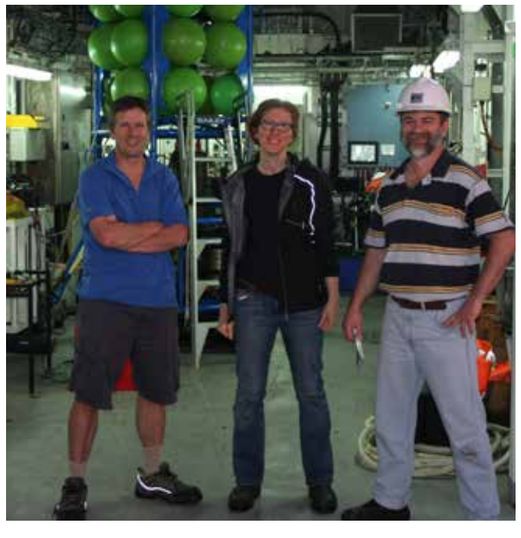




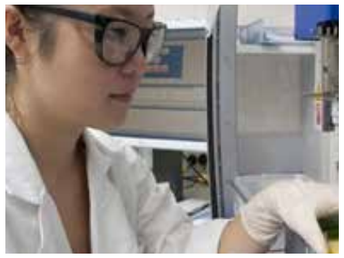








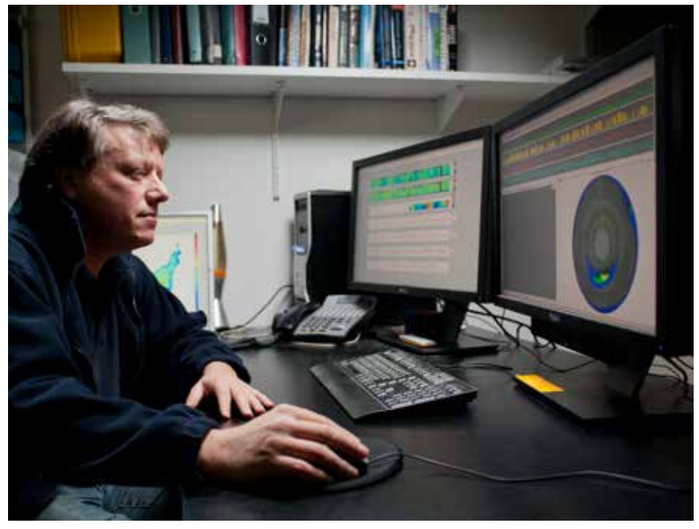










The Great Australian Bight Reseach Program Partners

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CSIRO

Government of South Australia
Primary Industries and Regions SA

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

THE UNIVERSITY of ADELAIDE

Flinders UNIVERSITY

To find out more please visit www.misa.net.au/GAB