



# THE GREAT AUSTRALIAN BIGHT RESEARCH PROGRAM

*Building a bigger picture of the Bight*



■ BP EXPLORATION PERMITS

*The Great Australian Bight Research Program is a four-year, \$20 million research program to improve understanding of the environmental, economic and social values of the Great Australian Bight.*

It is a collaboration between BP, CSIRO, and the South Australian Research and Development Institute (SARDI), the University of Adelaide and Flinders University.



# THE GREAT AUSTRALIAN BIGHT RESEARCH PROGRAM

*Building a greater understanding of the unique ecosystems of the Great Australian Bight is critical to ensure future development in this region is ecologically sustainable.*

## CONTENTS

Introduction	2
Sharing the Knowledge	4
The Team	4
Oceanography	6
Open Water Research	8
Sea floor Biodiversity	10
Apex Predators	12
Petroleum Systems	14
Socio-economic Analysis	16
Integration and Modelling	18
Contact	20



# RESEARCH PROGRAM

*One of the largest whole-of-ecosystem studies ever undertaken in Australia*

# INTRODUCTION

*The Great Australian Bight is a unique marine environment and an area of high conservation significance. Over 85% of known species in the region are found nowhere else in the world.*

The highly productive region is home to great white sharks and iconic marine mammals such as whales, seals, dolphins and seabirds. It produces 25% of Australia's seafood production by value, it supports Australia's largest commercial fishery by volume, the South Australian Sardine Fishery, as well as the valuable southern bluefin tuna, abalone and southern rock lobster fisheries. Aquaculture leases are spread along the coast and its coastal waters are significant for the region's indigenous communities. Large marine parks have been established within the Great Australian Bight which is also a prime tourist destination.

The Great Australian Bight has been identified as prospective for oil and gas, an important Australian industry. In 2011, BP was granted four exploration permits in the Bight, and chose to collaborate with some of Australia's pre-eminent science institutions to enhance everyone's understanding of this vast expanse of ocean and its surrounds.

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**This collaboration forged between industry and science is delivering one of the largest whole-of-ecosystem studies ever undertaken in Australia.**

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Relatively little physical, chemical and biological data have been collected in the region, especially from the deep water ecosystems of the central Bight.

The research program seeks to build the first integrated model of how the biological and physical systems of the Great Australian Bight are linked and influenced by the environment around them.

This will be vital information for all users of the Bight because it will provide a solid basis on which to measure possible human impacts and help industry and government plan for future activities.

**Left:**  
Understanding iconic species, such as the southern right whale, will underpin their conservation and management.

# SHARING THE KNOWLEDGE

Information gathered about this unique marine region will be crucial to help inform decision makers and ensure future developments co-exist with the Bight's environment, industries and community.

The knowledge will be shared

with other stakeholders, such as Commonwealth and State governments, and a diverse range of research, community and environmental groups through

presentations, science symposia and publications in science journals, and other published reports.

## THE TEAM

The Great Australian Bight Research Program combines the expertise, resources and capability of Australia's leading marine research institutes – CSIRO, the South Australian Research and Development Institute (SARDI), the University of Adelaide and Flinders University, as well as contribution from BP subject matter experts.

Multi-disciplinary research teams comprising more than 100 of Australia's top scientists and technical staff are focused on seven major research themes – oceanography, open water ecosystems, sea floor biodiversity, apex predators, petroleum systems, socio-economic analysis, and integration and modeling.

This globally significant study will

reveal new insights into how the Great Australian Bight ecosystem operates and provide a scientific basis for sound decision-making to utilise and protect the environment.

CSIRO, the Commonwealth Scientific and Industrial Research Organisation, is Australia's national science agency and one of the largest and most diverse research agencies in the world.

SARDI is the South Australian Government's principal research institute. Its Aquatic Sciences Division has particular expertise in marine ecosystems, oceanography, marine protected species, and fisheries resources sciences covering wild fisheries and aquaculture.

### Undertaking an ecosystem

**Right:**  
Multi-disciplinary teams will work together across the research program.

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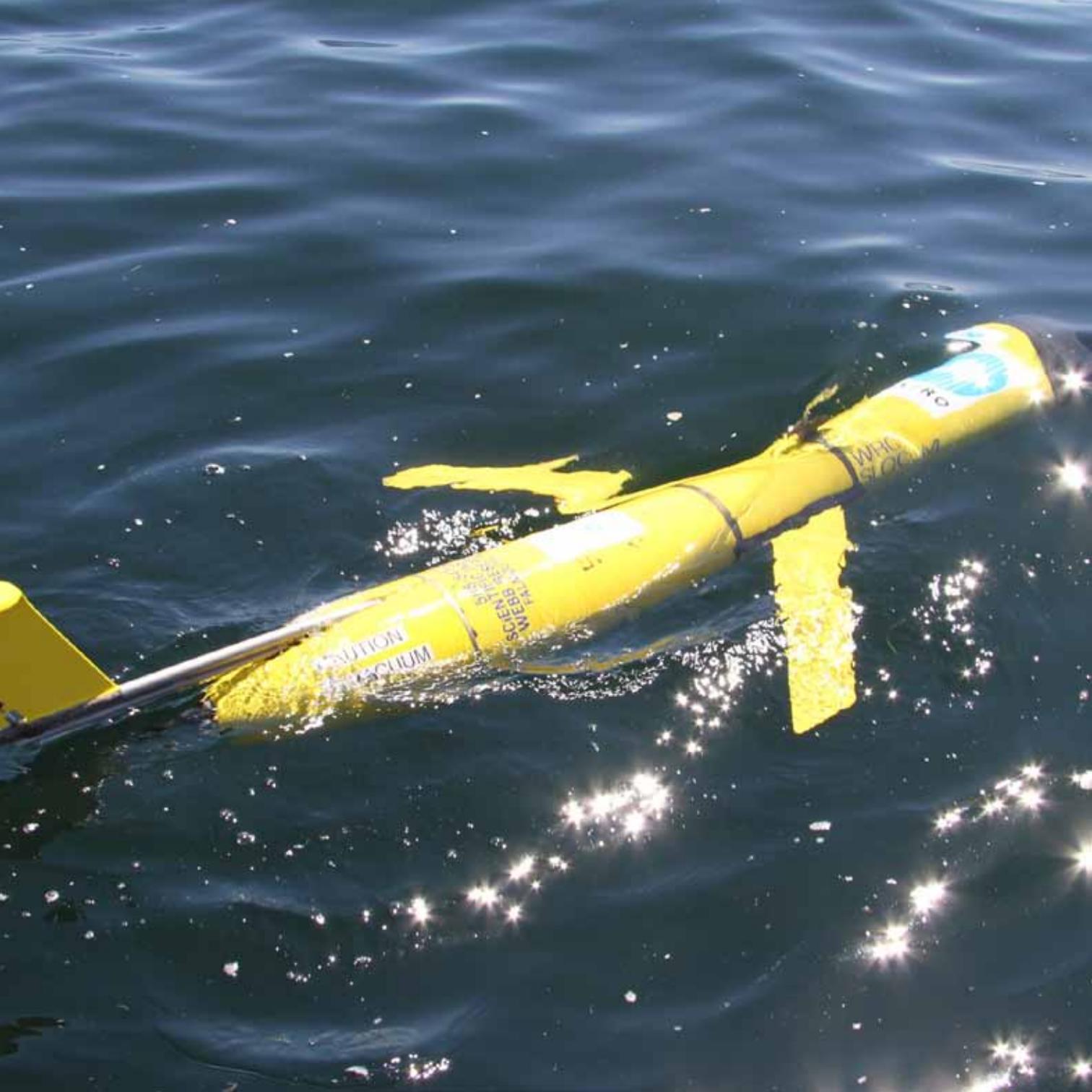
**program of this size and complexity is being observed with interest by research organisations, industry and governments around the world.**

The University of Adelaide is one of Australia's leading research-intensive universities and is consistently ranked among the top 1% of universities in the world.

Flinders University has an international reputation for high quality research that includes a strong record of discovery and innovation in the areas of marine, environmental and earth sciences.



P&O  
Marine Services



**Left:**

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

# OCEANOGRAPHY

*The Great Australian Bight is an especially dynamic body of ocean, and changes in ocean circulation and waves have a direct bearing on the marine ecosystem.*

The marginal sea of the Great Australian Bight is an extraordinary body of ocean with some physical characteristics that make it globally-unique and quite distinct from the adjacent seas west and east of Australia. Decade-to-decade, year-to-year and day-to-day changes in ocean circulation and waves all have a direct bearing on the marine ecosystem. The Oceanography research theme will develop a detailed understanding of the region's oceanography providing crucial knowledge for colleagues seeking to understand the pelagic and benthic ecosystems of the Great Australian Bight.

Researchers will develop hydrodynamic ocean models to gain a greater understanding of the connections between deep, off-shelf regions on the continental shelf and coastal regions, as well as the dynamic effect of the ocean on sea floor and ocean-dwelling food webs and biodiversity.

The computer models will simulate the day-to-day changes of ocean circulation and waves over many years. The accuracy of the models will be assessed using all available ocean observations.

Studying long-term changes in ocean circulation and the associated changes in the ecosystem will provide insights into how the two are linked.

This information will enable all circulation-dependent aspects of the ecology to be better understood. It will also determine regional connectivity for scenario studies and support sustainable management decisions.

**Principal scientists:**

A/Prof John Middleton SARDI  
Dr David Griffin CSIRO

# OPEN WATER RESEARCH

*Understanding the natural variability in the Great Australian Bight's pelagic ecosystem structure and function is necessary to help monitor and assess potential future human impacts.*

Researchers studying the pelagic or open water ecosystem will be looking at tiny organisms from microbes (viruses and bacteria), through to plankton (small plants and animals up to ~ 1 cm) and micronekton (crustaceans, small fish, squids and larger jellyfish up to ~ 10 cm) found in the shelf and deep Great Australian Bight waters. This represents the first comprehensive study of the deepwater pelagic ecosystem in this region. New specimens will include those collected from the deepest set of samples ever taken from the area, to depths of 3000 metres.

Scientists will collect information on the abundance and biodiversity of microbes, plankton and micronekton to assess food web dynamics in relation to changes in the physical and chemical environment.

Seasonal changes in oceanographic cycles, and the influence of upwelling and downwelling in the region may cause changes in the amount and type of nutrients available to primary producers. This in turn may lead to shifts in food web dynamics with implications for overall pelagic ecosystem productivity.

Understanding the way that changes in

the physical and chemical environment drive changes in food web dynamics will also contribute important information that will help to explain the way these changes affect the distribution and abundance of iconic species and apex predators.

## **Principal scientists:**

Dr Rudy Kloster CSIRO  
Dr Paul van Ruth SARDI  
A/Prof Tim Ward SARDI

**Right:**  
Water sampling at different depths assists in identifying changes in food web dynamics.





**Left:**  
Sea floor sampling will reveal unknown biodiversity in the deep water ecosystem.

# SEA FLOOR BIODIVERSITY

*Despite the high conservation significance of the Great Australian Bight's shallow benthic (sea floor) ecosystems, virtually nothing is known about benthic biodiversity in the region's deep sea where oil and gas exploration will be focused.*

The Great Australian Bight Research Program offers the first sustained opportunity to study the sea floor fauna and its environment in mid and lower continental slope depths at approximately 1000-2000 metres below the sea surface. Sea floor organisms are responsible for much of the secondary productivity of deep ocean waters, and ultimately underpin much of the food chain that supports a range of economically and socially important species including fishes. Benthic infauna living within the sediments include species with potential to indicate environmental impacts stemming from potential pollution events.

As many of these benthic fauna

are unknown, new and innovative approaches will be developed to identify them. Researchers will refine and apply the latest molecular techniques including 'DNA barcoding' to rapidly identify key taxonomic groups of the region. Research will measure the levels of naturally occurring hydrocarbons in the environment and benthic fauna, and predict if naturally occurring hydrocarbons are utilised by bacteria as part of the natural processes within the environment. This will provide an understanding of the relative levels of hydrocarbons occurring before oil and gas exploration commenced, as well as the capacity of the microbial biota to degrade enhanced levels of

hydrocarbons.

Studies of the abundance, diversity and distribution of indicator organisms and general biodiversity on the sea floor will be used to develop metrics to monitor long term changes, and to develop cutting edge molecular tools for rapid response environmental monitoring.

**Principal scientists:**

Dr Alan Williams CSIRO

Dr Jason Tanner SARDI

# APEX PREDATORS

*The Great Australian Bight is a regional hotspot for pelagic predators.*

Globally, it is the most significant feeding ground for juvenile southern bluefin tuna and is home to more than 80% of Australia's populations of Australian sea lions and New Zealand fur seals. The Great Australian Bight supports Australia's largest breeding aggregation of southern right whales which migrate to the region to calve in winter and provides critical foraging habitat for pygmy blue whales during summer and autumn. Millions of short-tailed shearwaters migrate into the region to breed and forage in its productive waters each year. The Great Australian Bight supports critical habitat for a host of protected and migratory species and several

threatened species, including Australian sea lion, southern right whale, pygmy blue whale and white shark. Surveys on their distribution and relative abundance in the region are needed to assess their risk from development in this region. Particular management requirements for threatened species under the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999 also need to be assessed.

Researchers will study the ecology and abundance of key iconic species including whales, dolphins, seals, seabirds, pelagic fish and sharks.

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**Migration paths, foraging, breeding and connectivity between species will also be studied, as well as the oceanographic processes that underpin areas of ecological significance.**

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This includes using animal movement data to determine critical habitats, identify Areas of Ecological Significance important to multiple species, migration paths, and the oceanographic processes that underpin key foraging areas.



A range of aerial and acoustic surveys, satellite tracking, tagging, field surveys, population counts and archival reviews of previous electronic tagging data will be used to gather this information. One of the projects will focus on southern bluefin tuna, which is a highly valued species targeted by commercial and recreational fisheries. The fish is of significant value to South Australia's regional economy. A \$200 million southern bluefin tuna aquaculture industry, based at Port Lincoln on the Eyre Peninsula, captures its juvenile tuna from the Great Australian Bight when they gather in the warm shelf waters each summer to feed on

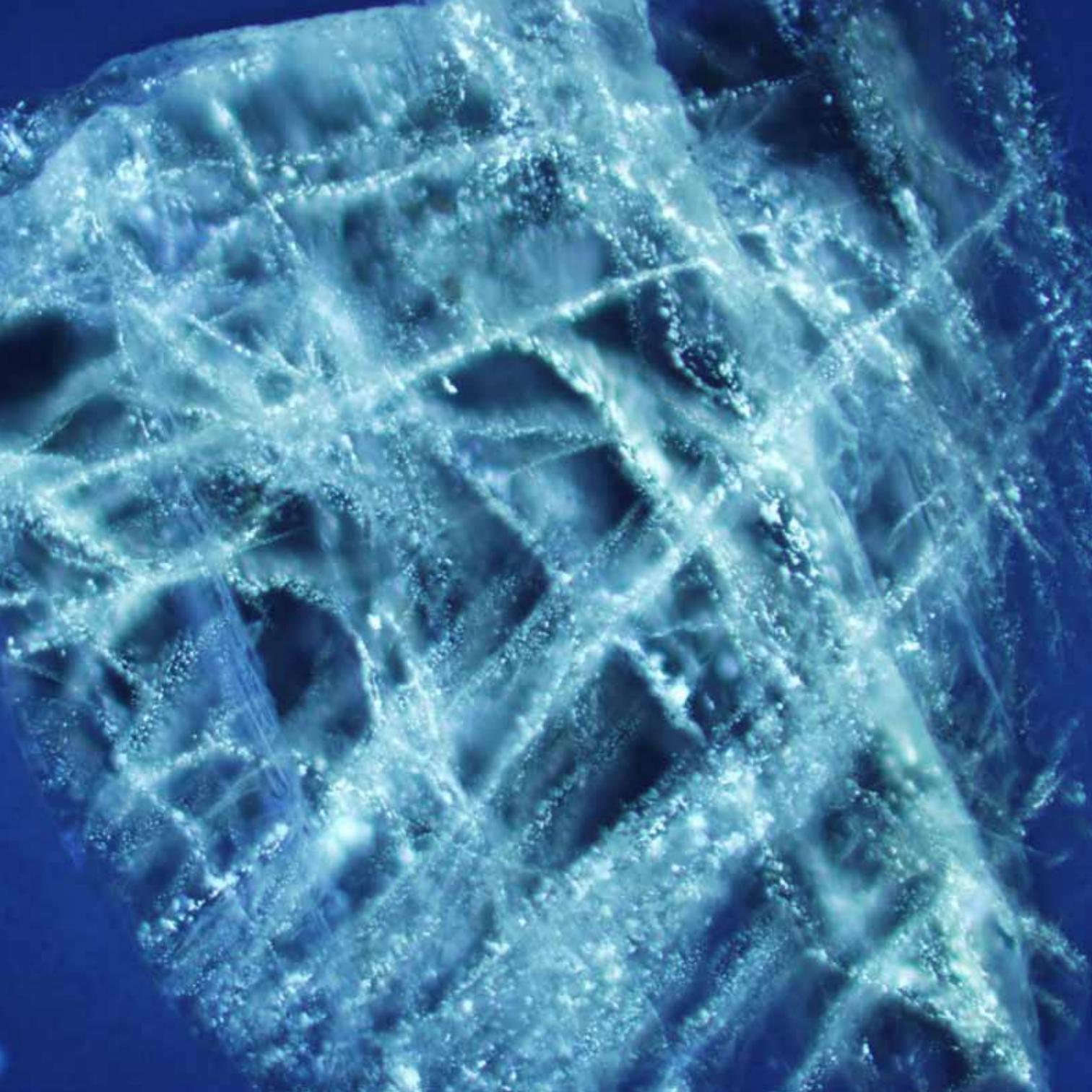
abundant prey species, especially sardines. These fish are captured in purse seine nets and towed to inshore ranching operations where they are grown out for the export market. The project will look at their spatial dynamics and any potential impacts of noise associated with oil and gas exploration, as well as the ecological role of southern bluefin tuna as an apex predator in the Great Australian Bight.

**Principal scientists:**

A/Prof Simon Goldsworthy SARDI  
Dr Campbell Davies CSIRO

**Above:**

Research will include the importance of this region to the threatened Australian sea lion. Image courtesy of Roy Hunt, Australian Geographic.



# PETROLEUM SYSTEMS

*Small balls of natural tar washed up on beaches along South Australia's Bonney Coast in the South East provided the first tangible sign of potential oil and gas reserves in the canyon systems of the continental slope.*

The Great Australian Bight Research Program geologists and geochemists will identify and characterise natural petroleum seepage in specific areas of the Bight. Currently, no liquid hydrocarbons have been recovered from the Bight and an active petroleum system has yet to be proven. The tar balls themselves may point researchers to the likely location of their parent seeps.

The geochemistry of the tar balls and asphaltites found on South Australia's beaches will be determined to identify their probable origins, as well as their geographic relationship to offshore surface and bottom ocean currents.

Their elemental, isotopic and molecular fingerprints will provide essential clues to the location of what, until now, has been a phantom petroleum system.

Complex studies will range from detailed 3D seismic data sets, looking at structural geology, identifying and characterising palaeo-hydrocarbon migration routes, geohazard and sea floor geomorphology, the physical and chemical attributes of the water column, water surface slick sampling and satellite remote sensing. This will be used to identify natural hydrocarbon seepage in the Great Australian Bight.

Researchers will also look at the environmental impact of asphaltites and tar balls on the sediment and biota of their stranding sites, and gain important insights from their stranding patterns.

#### **Principal Scientists:**

**Dr Andy Ross** CSIRO

**Dr Richard Kempton** CSIRO

#### **Left:**

Identifying traces of oil in sediments, such as sand grains from beneath the ocean floor (left), increase our understanding of the movement of hydrocarbons in the Great Australian Bight.

# SOCIO- ECONOMIC ANALYSIS

*Any potential oil and/or gas industry in the Great Australian Bight may change the structure of some regional communities in the aquaculture and dryland farming areas of Eyre Peninsula and the west coast of South Australia.*

Significant changes could occur if the results of exploration lead to the development of a gas and/or oil resource.

Understanding how these activities might reshape a community is crucial to ensure that change is positive and that potential benefits are fully realised both socially and economically, as well as how change can best be integrated.

Social science approaches will be used to form a baseline understanding of these communities, including how people living in the region connect and interact, how natural resources

are enjoyed, and how resilient communities are, as well as the structure of its labour force and how communities have dealt with change in the past. The region's economy and the processes currently driving development will be studied, with much of the information drawn from the Australian Bureau of Statistics Census data.

Researchers will also consult with the community about their concerns and perceptions of key issues regarding the likely future activities of the oil and/or gas industry.

**In addition, researchers will**

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**draw on the experiences of these regions in dealing with significant change over the past three decades with a decline in conventional agriculture, the rise of aquaculture and value-added fishing and finally, the emergence of mining.**

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The economic dependence of individual regional communities on activities related to the Great Australian Bight will be examined.

This knowledge will provide a baseline

**Right:**  
Understanding the socio-economics of the region will help guide future developments.

measurement against which any future changes may be assessed.

Major outcomes of the studies will include a benchmark of social and economic conditions. These will relate to the commercial fishing and aquaculture industries and recreational fishing, as well as the contribution that the Great Australian Bight makes to recreation and eco-tourism, and the contribution that these sectors make to the local economies.

**Principal Scientists:**

**Professor Andrew Beer**

University of Adelaide

**Dr Sean Pascoe** CSIRO

**Professor Mike Young**

University of Adelaide



# INTEGRATION AND MODELLING

*A major outcome of the Great Australian Bight Research Program will be the development of a powerful state-of-the-art modelling tool of the structure and dynamics of the Bight's ecosystem.*

This will integrate all the relevant data gained from the research program, as well as from previous studies.

Most importantly, it will provide the capability to translate this new knowledge into meaningful information about how the Great Australian Bight ecosystem functions, and the potential impacts of individual and multiple activities.

The computer model will enable the substantial information resource gained through this research program to be put to its best use, allowing a range of scenarios and potential management options to be tested to support whole of system management decision making.

Data included in the computer model will range from the key physical chemical and biological drivers of ecosystem structure; the vulnerability of key habitats and assemblages, trophic pathways and species; potential ecosystem stressors and their combined effects; and the social-economic and ecological trade-offs associated with multiple use.

The model can also be used to track events such as potential pollutants through the Great Australian Bight

food chain, harmful algal blooms, red tides and hurricanes, and how they might impact the ecosystem. Changes due to climate change will also be identified and forecast.

#### **Principal scientists:**

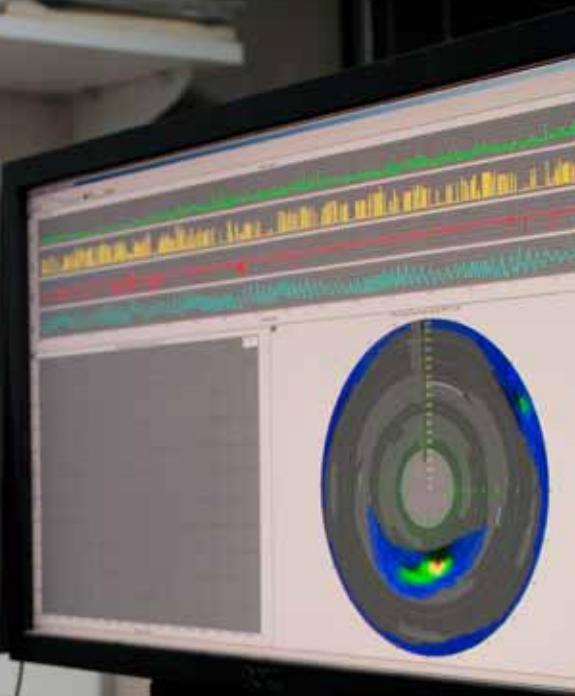
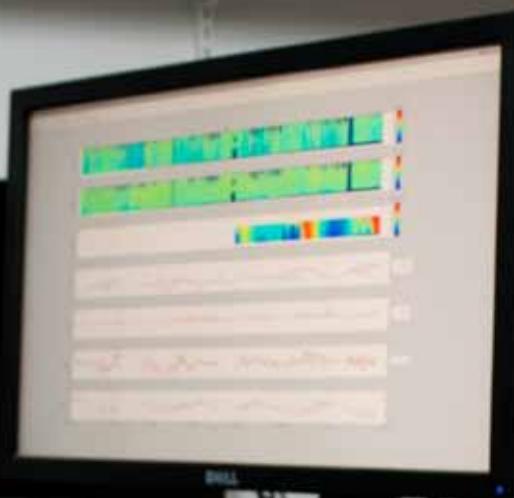
**A/Prof Tim Ward SARDI**

**Dr Beth Fulton CSIRO**

**A/Prof Simon Goldsworthy SARDI**

#### **Right:**

Computer models will be a key tool in understanding the dynamics of the region.





# CONTACT

*For further information about the research program visit [www.misa.net.au/GAB](http://www.misa.net.au/GAB) or contact the Research Office:*

**Dr Steven Lapidge**

Research Director  
Great Australian Bight Research Program  
Phone 0401 990 367 or  
[steven.lapidge@sa.gov.au](mailto:steven.lapidge@sa.gov.au)

**Ms Jane Ham**

Science Support Officer  
Great Australian Bight Research Program  
Phone (08) 8207 5458 or  
[jane.ham@sa.gov.au](mailto:jane.ham@sa.gov.au)

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Tracking data from multiple species will help identify areas of ecological significance. Image courtesy of Rodney Fox Shark Expeditions (right).



