# GENETIC TOOLS FOR MAPPING **LIFE IN THE DEEP SEA**

## At a glance

**Project title**
Genetic tools to assess deep sea biodiversity

**Project summary**
Development of genetic tools to rapidly and cost-effectively assess the biodiversity in the deep sea ecosystems of the Great Australian Bight.

**Project investigators**
SARDI, CSIRO and Flinders University

**Program partners**
CSIRO, BP, SARDI, the University of Adelaide and Flinders University are working on a $20 million research program to better understand the environmental, economic and social value of the Great Australian Bight.

**Project contacts**
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## Overview

Remote deep sea ecosystems such as the Great Australian Bight are increasingly becoming the focus of a range of commercial activities, including oil and gas exploration, shipping and fishing. However, our ability to predict, assess and monitor the environmental impacts of these activities is limited by the high cost of sampling in these difficult to reach places, and the lack of existing knowledge about the organisms living there.

As part of a broader program of research to understand how the Great Australian Bight ecosystem functions, we will be developing a range of genetic tools to rapidly and cost-effectively assess the biodiversity in these deep sea ecosystems. These tools will in particular focus on the smaller organisms which actually form a large component of the fauna, and which can play a critical role in ecosystem functioning. These include small worms and crustaceans that live in the sediments, which provide an important food source for larger fish and invertebrates such as crabs, and which are known to be good indicators of environmental impacts in shallower waters. We will also be focusing on hydrocarbon degrading microbes (bacteria and fungi) that occur naturally in response to hydrocarbon seeps. These hydrocarbon degraders also have the potential to bioremediate oil they come in contact with, so understanding their distribution and abundance could be beneficial.

## The Challenge

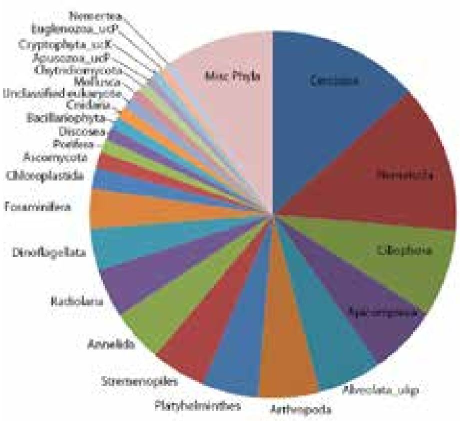
Little is known about the organisms living in many regions of the deep sea, including the Great Australian Bight, as they are remote and extremely difficult to access. However, with increasing commercial interest, it is essential to document what is there before any major developments occur, so that we can manage development in an environmentally sustainable manner. New techniques to quickly and cost-effectively map and quantify biodiversity are being developed. There have also been rapid advances in genetic techniques for identifying organisms in recent years, and genetic approaches provide high promise for identifying organisms from relatively easily collected environmental samples (for example, samples of seafloor sediment or water).

**Below:** *Sediment cores recently retrieved from the sea floor, prior to subsampling for molecular analysis.*

## The Research

Water and sediment samples from the Great Australian Bight were collected on a research cruise in April 2013. These samples came from water depths of 200-2000 m, and a total of 25 sampling sites spread over almost 500 km east-west.

Some of these samples are having DNA extracted from them, which will be sequenced to determine the taxonomic identity of the organisms present. Other DNA samples will be assessed for the presence of the genes that indicate hydrocarbon degrading activity, rather than to determine the identity of the organism itself. A further set of samples has been manually sorted to pick out the organisms present, and after they are identified by taxonomists, they will each have their DNA extracted and sequenced, so that we can match this DNA 'barcode' to the whole organism.




**Above:** *Distribution of eukaryotic taxa found in sediments from the Great Australian Bight.*

## The Impact

Rapid and cost-effective ecological monitoring of changes in biodiversity will allow ecosystem managers to detect fine scale changes due to natural and anthropogenic impacts and to better manage biodiversity conservation. Knowledge of the ecosystems natural ability to bioremediate oils will assist in responding to a potential release of hydrocarbons.

## The People

**Associate Professor Jason Tanner** of SARDI is a marine ecologist with a strong interest in the population and community ecology of benthic organisms. His research has included extensive field surveys, experimental work and modelling, and in recent years has focussed on predicting, quantifying, and remediating a range of human impacts on marine ecosystems.

**Professor Luciano Beheregaray** is an Australian Research Council Future Fellow and Head of the Molecular Ecology Group at Flinders University. His main interests are in evolution and conservation of aquatic biodiversity. His research illustrates how natural historians can contribute to our understanding of evolution and ecology and stimulate public interest about the importance of conserving biodiversity. A large component of the work carried out in his research group combines information from genomics and Earth sciences to understand the origins and evolutionary trajectories of populations and to inform conservation management.

**Associate Professor Anthony Chariton** is the Research Team Leader in Environmental Omics for CSIRO Land and Water. His research focus is on the development, application and integration of 'omic' technologies and traditional ecology for the monitoring and assessment of aquatic systems. In addition, he provides specialised environmental assessment, risk assessment and ecological expertise to a range of industry and government clients.

**Dr Sharon Hook** is a Senior Ecotoxicologist for the aquatic ecotoxicology group at CSIRO, Centre for Environmental Contaminants Research, Lucas Heights, Sydney. Sharon's research interests include applying modern –omics based approaches to environmental problems, determining the impacts of low level, long term toxic responses, and the design and implementation of toxicity

**Above:** *Extracting DNA from samples in preparation for molecular analysis.*

testing. Sharon has worked with a vast array of environmental contaminants, including metals, oil, and pesticides, and with a variety of taxa, from bacteria to fish.

**Dr Levente Bodrossy** joined CSIRO Marine and Atmospheric Research in 2010 to lead the development and application of cutting edge molecular approaches to reveal how complex microbial communities drive biogeochemical cycles. He is considered a world leader in high throughput molecular methods and microbial ecology. He was awarded the OCE Science leader's fellowship in 2013.

**Dr Alan Williams** is a CSIRO marine ecologist who develops and implements methods for mapping, characterising and monitoring deep sea ecosystems. His research contributes to a better understanding of deep sea ecosystems and the ways in which they are affected by human activities.


For more information

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