



# SERPENT

scientific and environmental roV partnership  
using existing industrial technology

# annual report 2006

collaboration... education... research... innovation...



**National Oceanography  
Centre, Southamton**

UNIVERSITY OF SOUTHAMPTON AND  
NATURAL ENVIRONMENT RESEARCH COUNCIL

# Foreword

2006 has been a year of consolidation for the SERPENT project, allowing us to cement existing relationships and develop new links whilst reacting to internal growth and change. We have worked hard to evolve and establish our science plans and are in the process of reaping the rewards, with large amounts of data to analyse and conclusions to be drawn from a year that has been extremely busy with offshore field work. None of this research would have been possible without the efforts of our partners and collaborators, and we would like to extend to them our thanks, as always, for helping us to carry out such a full programme of works.

One of our key developments in the UK this year was the identification of SERPENT as a strategic project within the Oceans 2025 research programme, run by the Natural Environment Research Council (NERC). Revolving around ten research themes from climate change to biodiversity and ecosystems, the driver behind the programme is to try to make a difference in securing the health of the oceans and seas for the future. The Australian arm of the project, SEA SERPENT, also received recognition in 2006 in the form of a three year funding award from the Australian Research Council. The new Linkage Project will aim to develop fundamental deep-sea science in the region to underpin environmentally sustainable drilling practices.

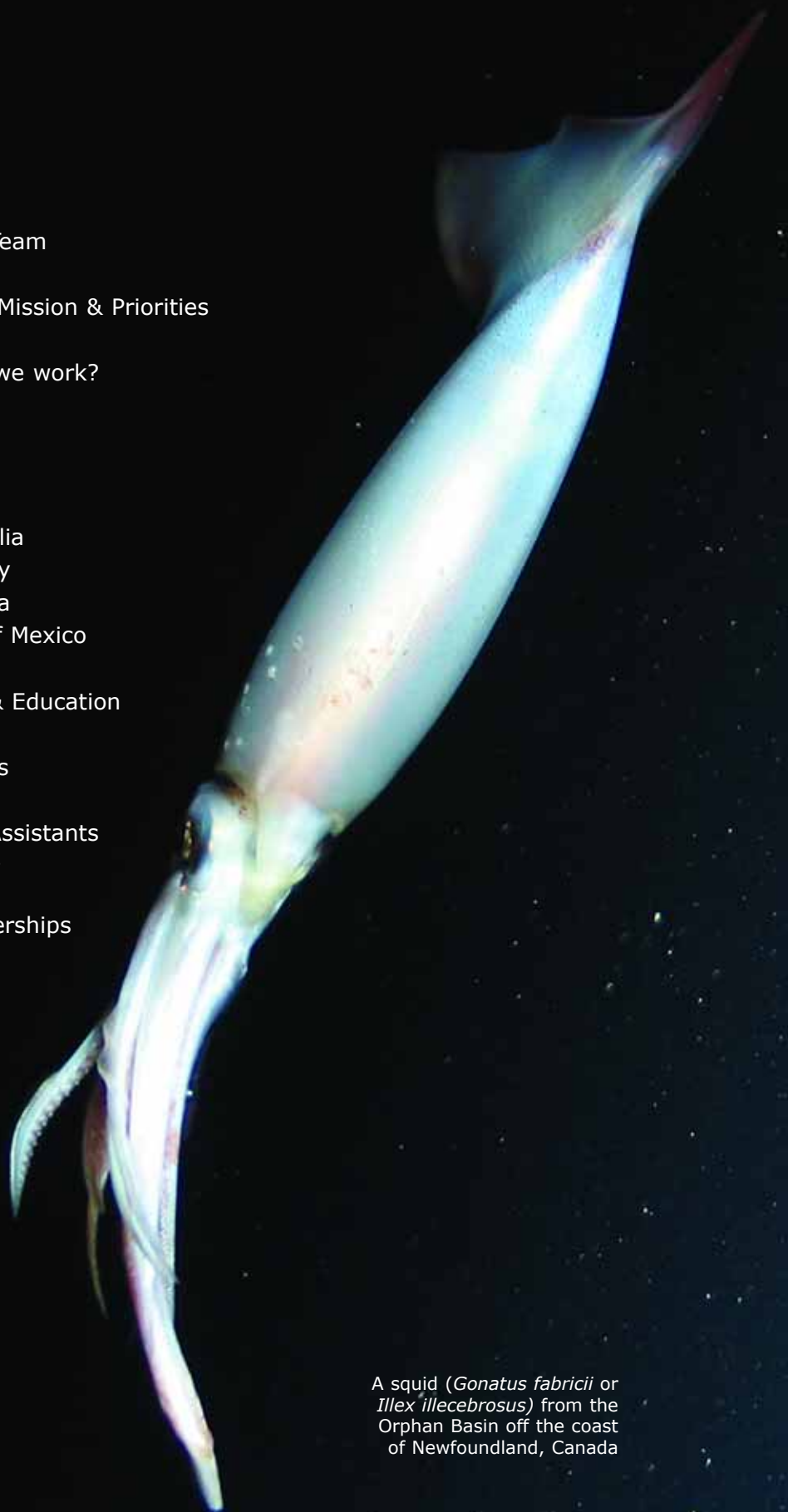
The year also saw some changes to our internal structure, with former SERPENT coordinator Dr Ian Hudson leaving for warmer climes and the running of the project handed over to our new team. These changes came at a time of growth within the project, allowing us the opportunity for each team member to focus on and develop different regions of activity while still offering each other strong support. Dr Daniel Jones and Dr Janne Kaariainen head-up the project's overarching science programme from the UK, with strong support from Dr Brian Bett and outreach from Lis Maclaren. Dr Ben Wigham is now based at Newcastle University, but continues to be closely involved in the North Sea SERPENT work with Emma Jones at FRS Marine Lab. SEA SERPENT remains coordinated by Dr Adele Pile at the University of Sydney, Australia, and Dr Mark Benfield continues to carry out mid-water research in the Gulf of Mexico. These strong alliances allow us to carry out as full a research programme as possible, exploring new techniques with a global coverage.

A host of new collaborations came to fruition in 2006, and we hope for more over the next year. The more global the reaches of deep-sea research the more power we have to try to ensure we protect these vital and unique ecosystems. Once again, we would like to thank everyone involved in the project, your input and support is extremely valued. We are looking forward to another year of exciting research and exploration, and hope that you enjoy digesting these highlights from 2006.

The SERPENT Team

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A squid (*Gonatus fabricii* or *Illex illecebrosus*) from the Orphan Basin off the coast of Newfoundland, Canada

# SERPENT Team

## SERPENT Research Team

Dr Mark Benfield, Louisiana State University

Dr Brian Bett, National Oceanography Centre,  
Southampton, UK (NOC)

Dr Daniel Jones, NOC

Dr Emma Jones, Fisheries Research Services, (FRS),  
Marine Laboratory, Aberdeen

Dr Janne Kaariainen, NOC

Dr Adele Pile, University of Sydney (UoS)

Dr Ben Wigham, Newcastle University

Dr Daniel Jones



Dr Brian Bett (right)



Dr. Emma Jones



Katie Robertson



Lis Maclaren &  
Dr. Janne Kaariainen



Iñigo Martinez

## SERPENT Outreach

Elisabeth Maclaren, NOC

## SERPENT Research Assistants

Claire Fletcher, NOC

Dr Andrew Gates, NOC

Katie Robertson, UoS

## Collaborative Research

Dr David Booth, University of Technology, Sydney

Dr Adrian Glover, Natural History Museum, UK

Professor C. William Keevil, University of Southampton

Professor Chari Pattiaratchi, University of Western Australia

Dr Danielle Skropeta, University of Wollongong, Australia

Dr Murray Thomson, University of Sydney

Memorial University of Newfoundland (MUN)

INIP – National Institute for Fisheries Research, Angola

BCLME (Benguela Current Large Marine Ecosystem)

## Associated Research

Dr Anthony Jensen, NOC

Dr Chris Hauton, NOC

Dr Lawrence Hawkins, NOC

## Graduate Researchers

Gareth Andrews, UoS

Andrew Guerin, NOC

Iñigo Martinez Saez del Burgo, FRS

Sarah Murty, NOC



Plumose anemones in the North Sea. Image supplied by Rovtech ROV crew, Heather Alpha jacket inspection

### Rationale

The SERPENT Project (Scientific & Environmental ROV Partnership using Existing iNdustry Technology) is a collaborative programme between scientific partners, institutions and a network of major oil and gas operators and contractors. SERPENT is hosted by the National Oceanography Centre, Southampton, one of the world's largest research and teaching organisations specialising in deep-sea science and oceanography. The project centres around the opportunistic use of ROVs (Remotely Operated Vehicles) in operational settings during periods of stand-by time and the wider utilisation of data collected as part of routine offshore work and environmental assessment studies.

### Our mission

"Through close collaboration with key players in the oil and gas industry, the SERPENT project aims to make cutting-edge ROV technology and data more accessible to the world's science community, sharing knowledge and progressing deep-sea research. The programme will interact with science and conservation groups globally and transparently communicate findings to the public to increase the awareness of the marine realm."

### Our Priorities

- Catalogue and describe marine species
- Examine global distributions of deep-sea species
- Examine effects of climate change in the deep sea
- Communicate key marine issues to regulators & industry
- Inform the public about the deep-sea environment
- Encourage best practice during offshore activities

Where do we work?





# UK

SERPENT research in UK waters continued steadily in 2006 and we have started to accrue some excellent data sets. Work around the Buzzard platform using baited camera techniques is providing North Sea research opportunities for two PhD students. The year also saw SERPENT become involved in research in the West of Shetland area on the biogeography of chemosynthetic fauna including the 'zombie worm', attracted by placing whale bones on the sea floor. Earlier SERPENT studies West of Shetland have delivered two scientific publications this year.

## North Sea: Buzzard Project

*Mission Partners: Nexen Inc., Fisheries Research Services, Marine Laboratory and Newcastle University*

Understanding the relationship between the fish and invertebrate assemblages and offshore installations is fundamental in assessing their impact in the marine environment. Key questions include: How do marine communities respond to drilling disturbance and to the physical presence of subsea structures in the long term? Who benefits and who doesn't? Even in the North Sea, a well studied area, there is still a lot we just don't know.



Through the SERPENT partnership, research scientists from the Fisheries Research Services, Marine Laboratory in Aberdeen, the University of Aberdeen (Oceanlab) and the National Oceanography Centre, Southampton, continue to collaborate with Nexen to study how local marine life is responding to one of their newest North Sea developments. The Buzzard site provides a unique opportunity to follow and evaluate this change from an exploited fishing ground through to a fully operational oil production area.

As this project started before the Buzzard platform had been constructed, no ROV was available and alternative sampling methods have been used to collect data, principally a stationary, baited time-



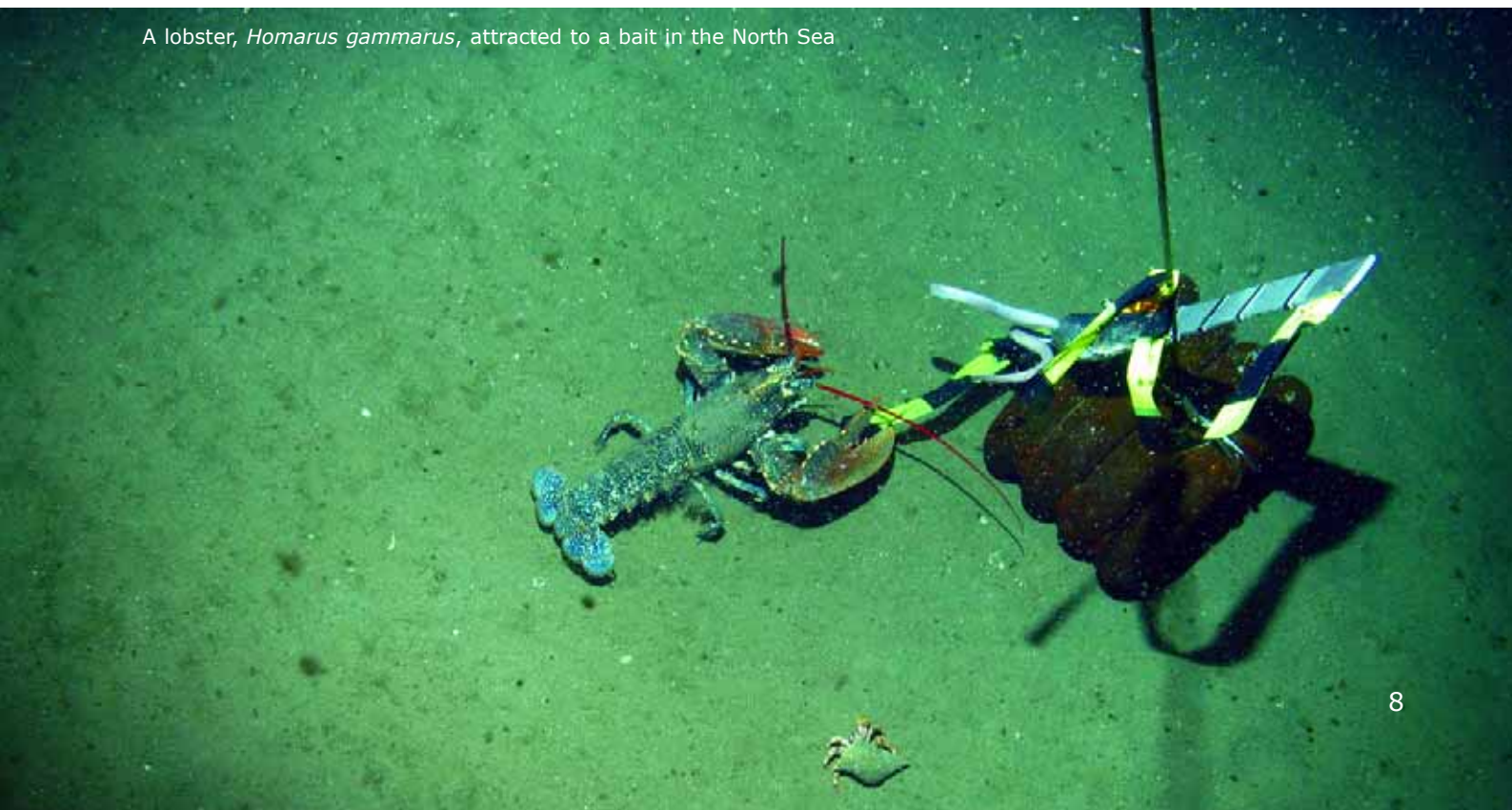
lapse camera that can be left *in situ* for hours, days or even months. The photos are analysed to assess species diversity, behaviour and abundance. The advantage of using this method is that it can be used both before and after installation, inside and outside the 500m exclusion zone. During 2006, two baited camera surveys were carried out at a control site, outside the exclusion zone, building on data collected in 2004 and 2005 prior to platform construction. In addition, a survey was also carried out inside the protected area, now closed to fishing. This was achieved by operating our camera from the stand-by vessel, BUE Lismore (Viking Offshore). The survey was the first SERPENT mission for new PhD student Iñigo Martinez, who is funded by an EU Marie Curie scholarship to study the impact of oil and gas installations on fish assemblages in the North Sea. With the professional and enthusiastic co-operation of the Lismore crew, the baited camera was deployed a total of 17 times for varying durations. An impressive 6,700 photos were taken, along with data on current direction and velocity, which will allow us to study the effect of the platform on species diversity and abundance as well tidal and diurnal patterns.

As the Buzzard platform moves into the production phase and the project moves into its fourth year, we aim to collect data from as close to the structure as possible. A maiden mission in early April was a great success, with the baited camera deployed five times from one of the platform cranes. Plans for another time-lapse camera system, with super

long-life batteries to be installed on one of the jackets will allow photos to be collected over a time scale of weeks to months. Although there isn't a work-class ROV currently stationed on Buzzard, Nexen are making previously collected video footage available, and the SERPENT team hope to take advantage of this year's structural inspection survey. Southampton-based PhD student, Andrew Guerin, has been studying the benthic organisms and encrusting fauna associated with rigs, using structural inspection footage from several North Sea platforms operated by BP and TOTAL. This is allowing us to build up a picture of the organisms that make up the fouling community of sub-sea structures of different ages in different locations, as well as how the species composition of this community changes with factors such as depth. Andrew will compare these data with the Buzzard inspection footage collected this year. With this information we can begin to consider how these structures might benefit other components of the local marine community as food sources or as habitat.

In 2007, the North Sea team hope to widen the project to collect video footage from oil and gas installations in various locations that have been in place for different lengths of time. This will build a picture of the diversity of marine communities associated with these 'artificial reefs' across the North Sea. Please let us know if you hold any ROV footage that could add to this research - enquiries to Emma Jones, FRS Marine Lab, [jonese@marlab.ac.uk](mailto:jonese@marlab.ac.uk)

A lobster, *Homarus gammarus*, attracted to a bait in the North Sea



The 'zombie worm', *Osedax mucofloris*.  
Photo by Dr A. Glover, Natural History Museum, London, UK

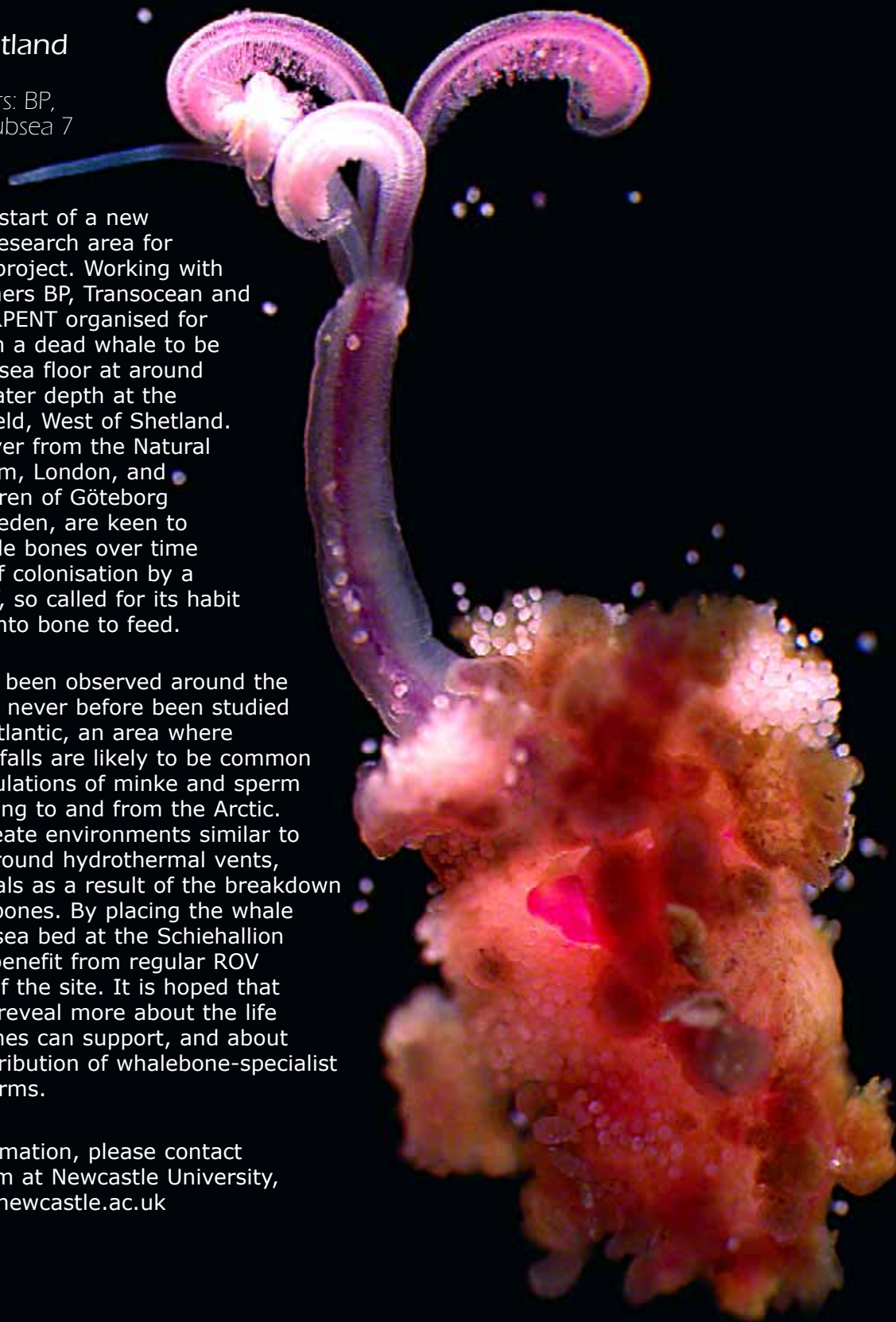
## West of Shetland

Mission Partners: BP,  
Transocean, Subsea 7

2006 saw the start of a new collaborative research area for the SERPENT project. Working with founding partners BP, Transocean and Subsea 7, SERPENT organised for vertebrae from a dead whale to be placed on the sea floor at around 300 metres water depth at the Schiehallion field, West of Shetland. Dr Adrian Glover from the Natural History Museum, London, and Thomas Dahlgren of Göteborg University, Sweden, are keen to study the whale bones over time for evidence of colonisation by a 'zombie worm', so called for its habit of burrowing into bone to feed.

The worm has been observed around the world, but has never before been studied in the North Atlantic, an area where natural whale-falls are likely to be common thanks to populations of minke and sperm whales migrating to and from the Arctic. Whale-falls create environments similar to those found around hydrothermal vents, rich in chemicals as a result of the breakdown of fats in the bones. By placing the whale bones on the sea bed at the Schiehallion field, we can benefit from regular ROV observations of the site. It is hoped that the study will reveal more about the life that whale bones can support, and about the global distribution of whalebone-specialist polychaete worms.

For more information, please contact  
Dr Ben Wigham at Newcastle University,  
[ben.wigham@newcastle.ac.uk](mailto:ben.wigham@newcastle.ac.uk)





## Faroes

This was the first year SERPENT worked in the Faroese sector on the northern flank of the Faroe-Shetland Channel. This channel is a very important area for SERPENT science; previously, we have only had access to this dynamic environment from the UK side. A total of four visits were made to the Stena Don exploration rig throughout the drilling programme at the Brugdán prospect.

### Brugdán

*Mission Partners: Statoil, Stena, Oceaneering*

Thanks to Statoil, SERPENT were able to get excellent access to the Stena Don, a Stena Drilling rig equipped with an Oceaneering Magnum ROV. The 480 metre deep seabed had a wide range of creatures typical of the arctic seas, usually found deeper on the southern flank of the channel. Missions were carried out by Dr Daniel Jones and Dr Janne Kaariainen before drilling had occurred and at three time points throughout the drilling operations.

With this level of access we were able to collect a large amount of scientific data for a number of projects. Our principal aim was to assess the effects of disturbance from drilling on the environment. We were particularly interested in evaluating the large megafauna (greater than 5cm in size) and the small meiofauna (smaller than 0.05mm) and their specific responses to disturbance and changes in their habitat.

Throughout the operations we were able to collect high-quality digital still pictures and video, in many cases these animals have not been photographed alive before and as such provided important information on behaviour and appearance in life. We also collected a wide range of taxonomic samples from scavenging crustaceans to fish, which will be analysed in 2007 and will enable us to accurately identify the specimens in the photographs.

# Australia

## Enfield Site

The Enfield development is situated approximately 40km offshore, north-west of Australia's North West Cape. The site lies close to a number of environmentally sensitive areas including the Ningaloo Reef and associated Marine Park. At its closest point, the development is located approximately 35 km from the North West Cape and 16 km from the boundary of the Ningaloo Reef Marine Park (Commonwealth Waters). The water depth across the licence area varies from 400 metres in the east to over 550 metres in the west.

## Thylacine Site

The Thylacine development field lies 70 km south of Port Campbell, Victoria. Development is based on a remotely operated platform that was completed in March 2006 and offshore and onshore pipelines and a gas processing plant located about 6 km north of Port Campbell, (200 km south-west of Melbourne). The water depth is 100 metres.

## Mutineer Site

The Mutineer field lies 150 km north of Dampier in the Carnarvon Basin, in 140-160 metres of coastal waters off the north west coast of Australia. Production in the field commenced in March 2005.

Two grenadiers (family Macrouridae) at the Enfield site



## Enfield 4

Mission Partners: Woodside, Transocean, Subsea 7

Over the last two years, the Enfield site has formed a large proportion of our research. The first mission of 2006, was out to Enfield on the Jack Bates semi-submersible drilling rig. This mission expanded on previous ROV video surveys to provide quantitative data on megafaunal ecology; particularly abundance, diversity and distribution in this area. We also carried out experiments to determine the effects of drilling on heat shock protein (hsp) expression in deep-sea scavengers.

Five days of ROV operations allowed completion of eight video transects that were analysed for megafaunal diversity and habitat mapping, contributing to the Honours Project of Katie Robertson from the University of Sydney. The soft bottom environment discovered at this location is similar to that of the other Enfield sites visited last year. There was no evidence of any rock formations or hard bottom of any type. Analysis of video footage indicates a high density and diversity of megafauna. The main component of the megafaunal community is consistent with soft bottom communities and includes echinoderms (asteroids and echinoids) a host of crustaceans (prawns and large isopods), eels that live in the sediment and some bottom dwelling fish.

The mission repeated previous heat shock protein experiments. Baited traps deployed within and outside of the drill spoil, attracted mobile megafauna, including large numbers of shrimp, not present on previous missions. A variety of prawns, crabs, hagfish, amphipods, isopods and fish were attracted to the baited traps. Shrimp and amphipods from within the spoil area and shrimp, amphipods, hagfish and isopods outside of the spoil were collected for heat shock protein analysis. Initial examination of the data suggests that there is a difference in the diversity of organisms that visit the traps (inside vs outside the drill spoil). Isopods and hagfish only appeared to visit traps outside of the drill spoil.

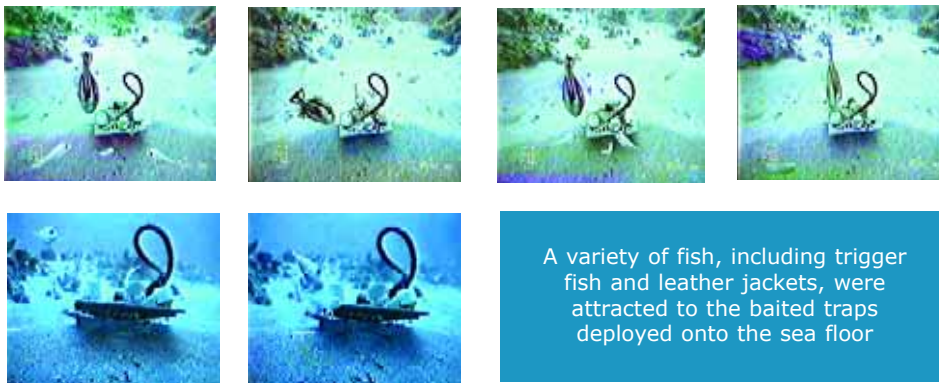
This mission also saw the successful completion of an *in situ* exposure experiment. *Bathynomous pelor* isopods were collected outside of the spoil and re-deployed within and outside of the drill spoil. Controls were brought to the surface and frozen and procedural controls were re-immersed to the sea bed and brought back to surface after eight hours. The acute *in situ* exposure of isopods to drill spoil on the sea floor did not result in hsp70 expression in all tissues or all treatments. There was no expression of hsp70 in either the respiratory or swimming pleopods of the isopods across any of the treatments. Expression of hsp in the tail muscle of isopods deployed within the drill spoil is nearly twice that of the amount in the maxillary glands.

## Thylacine Area

Mission Partners: Woodside, Mærsk, TMT

In May 2006, Dr Adele Pile and Gareth Andrews visited the Mærsk Guardian in the Bass Strait. Two days of ROV operations allowed the completion of video transects to assess megafaunal abundance, diversity and distribution in the area.

Rock escarpment served as the primary habitat for a dense sponge and coral reef. The rock formations have a spur and groove pattern. Grooves are filled with sediment, while spurs have dense communities of sponges, soft corals, bryozoans and ascidians. Associated with this community are fish assemblages, including leather jackets, trigger fish and seahorses. Drill spoil is restricted to a radius of about 30-50 m (port aft side), and as in the other sedimentary areas, is settling into the grooves. Ripples in the spoil indicate significant bottom currents. There is an area where the spoil layer has covered the escarpment, but the fan, tube and finger sponges rise above the spoil. The sponges all appear healthy with no lesions or bleaching. Fish still inhabit the area of dense spoil sponge communities. There is evidence of worm re-workings in sediment areas 30-50 m from the drilling activity. There are large areas of sediment covered escarpment that have a much coarser sediment and ripples with a greater wave length suggesting that this sedimentary deposition was the result of a past storm.



Crabs, cuttlefish and fish were attracted to the baited traps that were deployed within and outside of the drill spoil. Initial examination of the data suggests that there is no difference in the diversity of organisms that visit the traps (inside vs outside the drill spoil). Behavioural observations at the baited traps revealed the tracks of many of the megafauna and this was then used for the identification of lebensspuren (animal tracks).

Food choice arrays were deployed within drill spoil both day and night, and then videoed, to determine the food preference of benthic fauna. Food choice consisted of six agar blocks: a natural and artificial protein source, a natural and artificial carbohydrate source, a natural lipid source, and agar as a control. Fish were immediately attracted to the blocks during the day and fed primarily on the natural and artificial protein and lipid blocks. Crabs were attracted to the blocks at night but ate from all blocks. Videos will be further analysed for behavioural observations to determine any dietary preferences.

## Australia: Mutineer Subsea Field Development

Mission Partners: Woodside, Mærsk, TMT

In August, Gareth Andrews visited the Ocean Bounty semi-submersible drilling rig at the Mutineer Development to conduct research contributing to his Honours project. This mission focused on determining the nutritional ecology of this location, in particular, the nutrient selection behaviour of the urchin *Diadema* sp. This mission also looked at the impact that anthropogenic disturbance events have on deep-sea communities. Detailed ROV megafaunal video transect surveys were also carried out as on previous missions. Mutineer is a soft bottom environment, in 146m water depth. Large communities of sea urchins were discovered on this mission, along with anemones and encrusting sponges.

Feeding choice arrays similar to those deployed during the Thylacine mission were also deployed at Mutineer, to monitor the behaviour of benthic scavengers and to determine if there are any dietary preference of these scavengers. Feeding plates were deployed on the open seabed as well as in caged experiments, with the *Diadema* sp. Nutrient selection behaviour of *Diadema* sp. on the seabed was monitored, and the urchins showed a clear preference for high-protein food blocks (squid-based). In caged experiments, a shift in preference from protein to kelp and seagrass was apparent. This suggests that *Diadema* sp. were protein deprived and were seeking to redress a nutrient imbalance by increasing their intake of protein. Having redressed this nutrient imbalance they returned to a high-carbohydrate, plant-based diet. Stable isotope analysis showed *Diadema* sp. to be omnivorous.

Baited traps were deployed within and outside of the drill spoil to attract mobile megafauna. There was no activity recorded and no evidence of lebensspuren around the traps. Four 40m video transects were completed, for megafaunal abundance, diversity and distribution in the area. Videos will be analysed for megafaunal diversity and habitat mapping over the coming year.



A *Diadema* sp. urchin on the seabed



**A burrowing anemone from the Morvin prospect**

## Norway

### Morvin

Mission Partners: Statoil, Oceaneering  
SERPENT scientists Dr Janne Kaariainen and Nina Rothe visited the Morvin location; a deep-water Statoil prospect on the Norwegian Margin. Based on the West Alpha rig and using Oceaneering Magnum ROVs the scientists were able to map disturbance patterns and take sediment samples at this location.

This mission was used to trial a number of new approaches developed to quantify changes in ecosystem functioning and biological community composition in response to drilling related operations. For example, we deployed a modified ROV operated Ekman Grab for the first time to collect sediment samples for assessing patterns in macrofaunal communities.

An experiment to investigate bioturbation was also trialled at Morvin. This experiment uses non-toxic luminous tracer particles to quantify the rate of biological reworking of sediment.

Bioturbation is a very important process in recovery from disturbance yet very little information on rates is available for deep-sea locations.

### Edvarda

Mission Partners: Statoil, Oceanrig, Oceaneering  
Dr Janne Kaariainen carried out one scientific and one media visit to the exploration rig Eirik Raude at the Statoil operated Edvarda prospect in May and June 2006. Edvarda is located in the deep Norwegian Sea (1700 m) and proved to be very interesting scientifically. The sediment environment was characterised by unusual features probably related to pockmark activity as well observations of rapid transportation rates of drill spoil and surface sediments.

As SERPENT operations commenced pre-drilling, we were able to deploy sediment marker buoys to measure the vertical deposition height of drill spoil. In conjunction with our ROV visual spoil extent mapping, we



have gained a very good understanding of the post-depositional environment guiding the biological sediment sampling programme during the science visit. These samples are now being analysed for changes in body size structure and the role the organisms play in the sedimentary environment as a function of increasing distance from the well centre.

The biological observations in this area were similarly exciting, with both ROV video transects and baited experiments providing footage of some rarely seen organisms. Deep-sea octopus and bioluminescent comb jellies were caught on film, as well as evidence of interesting behavioural patterns such as amphipods regularly inhabiting crinoid stalks.

## Tornerose

Mission Partners: Statoil, Transocean, Oceaneering

Dr Daniel Jones visited the Transocean semi-submersible drilling rig Polar Pioneer while it was drilling an exploration well in the Barents Sea for Statoil. A two-week visit enabled a number of projects to be carried out including obtaining samples for subsequent molecular analysis. These samples will be used to investigate the physiology of echinoderms, such as starfish, through molecular methods. This will give us a much better understanding of the potential sub-lethal effects of drilling disturbance that may not be obvious from photographs.

The Arctic Barents Sea area at Tornerose is an extremely interesting area for deep-water biology. Despite its high latitude, water temperatures are higher (1°C) than many of our other sites in the deep Faroe-Shetland Channel. Large numbers of commercially important fish, particularly cod, were seen during operations. Because of the sensitivity of the environment very strict controls are put in place on drilling. Through SERPENT work we are starting to evaluate the field effects of drilling activity on these ecosystems, allowing for future mitigation of impact.

At Tornerose, like many other sites this year, we deployed scavenger traps, a simple baited system effective in capturing deep-sea scavengers, particularly amphipods and hagfish. These traps help us to gain a much better understanding of the distribution and biogeography of these species.



A cirrate octopus, possibly *Cirroteuthis muelleri*, filmed at about 1700 metres water depth at the Edvarda site

# Canada

Expanding our geographical reach to the deep waters off the Canadian coastline, the SERPENT Project has recently formalised an agreement with Chevron Canada Limited to carry out research in the Orphan Basin area north of the Grand Banks, 390km northeast of St. John's, Newfoundland and Labrador. The region represents a relatively unexplored deep-sea location, both from an ecological and an oil and gas perspective.

## Great Barasway

Mission partners: Chevron Canada Ltd., Oceaneering, Ocean Rig  
SERPENT had another opportunity to work from the Eirik Raude this year as the rig had relocated from Norwegian waters to eastern Canada to operate for Chevron and its Orphan Basin co-venturers, Shell Canada Limited, ExxonMobil Canada Limited and Imperial Oil Resources Ventures Limited. The Great Barasway site, in 2,338m water depth, offered scientists from SERPENT, Memorial University of Newfoundland and the Canadian Department of Fisheries and Oceans a unique opportunity to use an ROV to characterise the local biological communities and improve understanding of how these ecosystems function. New data, including high resolution imagery, has been collected on what actually lives at this depth in this very remote area.

As part of these operations we collected large quantities of high-resolution video and imagery of the local fish and megafaunal organisms. These visual observations have been complemented by actual specimen capture that will help the taxonomic identification process. These data, combined with biological sediment samples, will considerably improve our current knowledge of deep-sea biology in the Orphan Basin and may even reveal new deep-water species.

We successfully trialled and deployed four settlement arrays at the Great Barasway location, mimicking a range of substrata including rock and sponge. These devices were developed by Memorial University to evaluate the type of settling species and rate of recolonisation during the several months of deployment, indicating how quickly subsea structures will become recolonised and by which species.

A ray, possibly *Bathyraja spinicauda*, attracted to a baited camera in the Orphan Basin



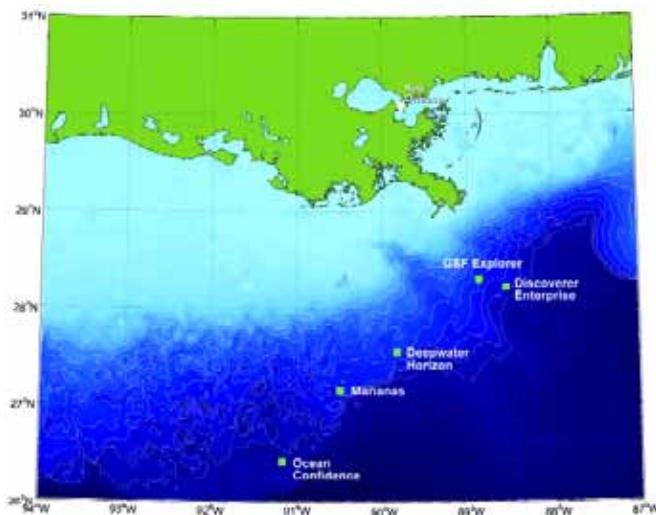
A chimaera rabbitfish, *Hydrolagus affinis*, caught on camera in the Orphan Basin



# Gulf of Mexico

In 2006 the Gulf of Mexico SERPENT Project began collecting data on planktonic and nektonic organisms in the northern Gulf of Mexico. The focus of this component of SERPENT is to conduct research on marine life in the epipelagic (0–200m), mesopelagic (200–2000m) and bathypelagic (2000–4000m) zones. Collectively the waters, down to about 3000m depth, represent approximately 66% of the total volume of the ocean. Moreover, these waters support very high biodiversity, and many of the species below the epipelagic zone are poorly understood and seldom sampled.

The northern Gulf of Mexico contains large numbers of rigs. Recent Minerals Management Service data indicate approximately 54 facilities operating beyond the 200m isobath. The ROVs aboard these rigs, drillships, and platforms provide a unique capability to further our understanding of marine life in the deep Gulf. Our target organisms include, but are not limited to: fishes, cephalopods, crustaceans, jellyfish, siphonophores, ctenophores, appendicularians, pyromes, salps, colozoans, and pelagic echinoderms.



Deepwater ROV sites contracted by BP where plankton surveys were conducted in 2006. Site visits were made to all sites except GSF Explorer, which provided video data to us based on our published ROV survey protocol



A viperfish *Chauliodus sloani* observed below Green Canyon 821 during a riser inspection

Funding for our project was initiated with a grant from the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration. Our project was initiated with BP using ROVs operated by Oceaneering. BP's Environmental Coordinator in Houston, Terry Rooney, arranged for five of their deepwater sites to provide us with access to their ROV resources. Our study began working with Transocean's Marianas, Deepwater Horizon, and Discoverer Enterprise, Diamond Offshore's Ocean Confidence, and the Global SantaFe Explorer.

Preliminary visits to the Discoverer Enterprise and Ocean Confidence enabled us to work with the ROV pilots and develop effective survey methodologies for studying floating and swimming marine organisms. Three different types of surveys were designed. Post-riser inspection surveys are conducted following a descending examination of the riser. Dedicated surveys can be conducted whenever a sufficiently large block of time is available, and opportunistic surveys occur during routine work when something interesting is observed and can be videotaped.

Undergraduate education is a major component of this project and we were fortunate to recruit Tanya Ribakoff from Eckerd College in St Petersburg, Florida as a summer student intern. Tanya was recruited via the Marine Advanced Technology Education (MATE) Center operated through Monterey Peninsula College in California. Tanya spent six

weeks based at Louisiana State University and worked offshore with ROV operators at our partner field sites.

Tanya hit the ground running. Within five days she had completed HUET, SafeGulf, and BP HSE training and was offshore on the Marianas six days after her arrival. The crews of the offshore sites provided Tanya with a fantastic opportunity to work with their ROV systems. Through their dedication and expertise, we were able to document a remarkable assemblage of marine life. For example, from just one six hour dive beneath Marianas, we were able to observe at least twenty four different species, with multiple observations of many of these types.



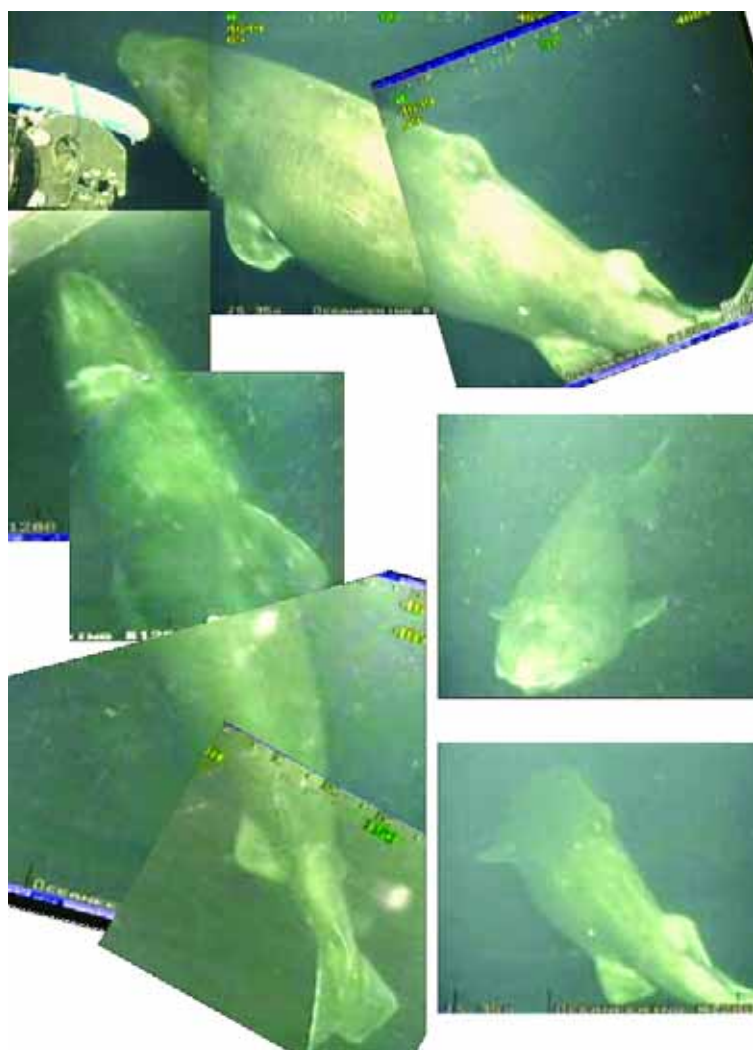
A large, red, lobate ctenophore recorded beneath MC682 as an opportunistic encounter. The features of this organism are consistent with the species *Lampocteis cruentiventer*, which was first discovered in 2001. This appears to be the first record of this species from the Gulf of Mexico

The project has recorded a number of firsts. We have the first record of the giant scyphozoan jellyfish *Stygiomedusa gigantea* from the Gulf of Mexico; what is probably one of the first records of a Greenland shark *Somniosus microcephalus* from the Gulf; and potentially the first record of a recently discovered deep-sea ctenophore *Lampocteis cruentiventer* from the Gulf of Mexico.

Analysis of our dataset is progressing and video of identified organisms continues to be uploaded to the SERPENT website. Over the next three years we are going to continue our research at BP sites and expand our program to include Subsea 7 ROV operations. So far we have barely scratched the surface of the potential for scientific discovery in the Gulf of Mexico using industrial ROVs. We are excited about the prospects for future exploration in this largely unexplored region.



Undergraduate student intern Tanya Ribakoff next to an Oceaneering ROV on the deck of the Transocean Deepwater Horizon



Composite and still images of what appears to be a female Greenland shark (*Somniosus microcephalus*) at a depth of 1423 m beneath the Deepwater Horizon semi submersible rig

# Outreach & Education

## SERPENT Communications

The SERPENT Scene newsletter is a regular quarterly publication, featuring short SERPENT news items from all over the world, and aims to be a quick and easily understood summary of the project's activities. The newsletters have prompted positive feedback from a variety of sources and seem to be a useful awareness tool.

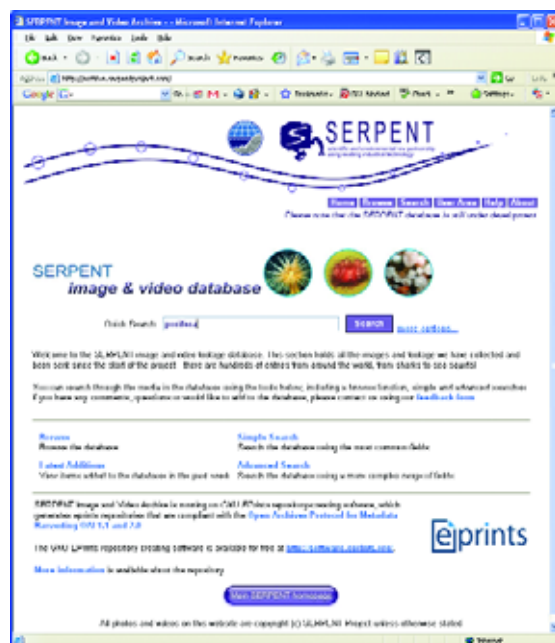
Our ROV information pack has recently been redeveloped and is available for download by ROV teams from the website. It includes guidelines on how to carry out video transects, sampling techniques and tips for taking photographs of life in the deep sea.

A set of large banners are currently under development collaboration with BP, and will be exhibited in the Natural History Museum in Luanda, Angola, later in 2007. These will help to raise awareness of the deep sea in an area that is rich in biodiversity, with a target audience of school children and the general public.



## Website

The website is constantly updated and developed with the latest information about the project, images and videos. A new tool is now being used to assess the number of hits, most visited pages and location of visitors to the site. Approximately 2,000 visitors a month, each visiting on average four pages each are accessing the website. Coverage is encouragingly global, with hotspots in the UK, Norway and Japan.



## Image and video database

Over the course of the last year, the project has invested a large amount of time in the development of a new web-enabled, searchable image and video database. This will allow visitors to the site to search through all the images (animals, sea-bed features, technology etc) held by the project by entering a wide range of search parameters. This new database has been developed using an E-prints system and as such will also be an extremely useful repository, ensuring that data is captured for the long term and is easily shared internally and at different institutions around the world.

## Media

The BBC's flagship high-definition series, Planet Earth, required innovative ways of gathering footage, and hence called on the Natural History Unit's existing relationship with NOC and SERPENT. Their next big series airing in 2009 looks set to call upon our collaboration again. High quality programmes such as these are an excellent way to raise awareness of the deep ocean, with enormous global viewing figures.



SERPENT also worked with the makers of 'Ocean Odyssey' in 2006, which followed the life of a sperm whale from infancy to old age and was shown on BBC1. In addition to providing real-life footage for the production company to emulate, the project also inspired some of the computer-generated scenes in the programme.

The project has been fortunate to receive fairly extensive media coverage over the last year, from Norway's TV2 and Russian NTV to the BBC's Radio 4 science programme, Material World and the BBC World Service. Details about our general interest and scientific publications can be found in the publications section overleaf.

## Events

### Southampton Boat Show

The Boat Show in Southampton, UK, is a huge event each year and SERPENT has been represented via the University of Southampton stand for the last two years. With over 100,000 visitors over a ten-day period, the event allows us to engage members of the public that we might not otherwise be able to reach. We provide leaflets and handouts at the show about the project, and display SERPENT footage on a plasma screen on the stand to draw people in.

Southampton Boat Show. Image courtesy of Ralph Hodgson





Visitors at National Science and Engineering week

#### *National Science & Engineering Week*

The British Association for Science holds an annual week-long event in March to promote science to all ages, focussing on school children. This year SERPENT once again took part in the special 'Ocean and Earth Day' at NOCS, which attracted around 1,500 children and their families. We had a larger stand this year with a variety of activities for kids and their families, as well as giving a talk about the project. The event increased awareness of the technology for exploration of the deep sea and the biodiversity that can be found there.

#### *11th International Deep-Sea Biology Symposium 2006*

This prestigious event was hosted in Southampton and drew together deep-sea biologists from around the world. SERPENT received generous coverage throughout the event, with the potential for distributing materials such as the annual report, in addition to the organisation of the associated BP Kongsberg Image Competition. The competition received worldwide media coverage, and SERPENT also received much interest through running and hosting the images on the website. The symposium also allowed the team to further develop new links throughout the deep-sea scientific community.

#### **Presentations to schools and groups**

Members of the SERPENT team visited several schools and educational groups this year to give presentations about the project and to raise awareness of the deep sea. The total audience number at talks given this year is in the region of 500. The schools and groups include: National Science Week visitors, Oaklands School Southampton, Wallingford School Oxford, Guildford University of the 3rd Age and the Royal Southern Yacht Club.



# Publications

## Selected Publications

### Peer Reviewed

Jones, D.O.B., Wigham, B.D., Hudson, I.R. and Bett, B.J. (2007) Anthropogenic disturbance of deep-sea megabenthic communities investigated using Remotely Operated Vehicles (Faroe-Shetland Channel, NE Atlantic). *Marine Biology* DOI 10.1007/s00227-007-0606-3

Jones, D.O.B., Hudson, I.R. and Bett, B.J. (2006) Effects of physical disturbance on the cold-water megafaunal communities of the Faroe-Shetland Channel. *Marine Ecology Progress Series* **319**: 43 - 54

### Non-Peer Reviewed

Hudson, I.R. and Jones, D.O.B. (2006) SERPENT: Video and Images from Global Oil and Gas Operations. In: Charlesworth, M. E.(Ed) *Marine and Coastal Photographs and Videos: their availability, uses and curation*. Marine Environmental Data Action Group of the Inter-Agency Committee on Marine Science and Technology. Liverpool

The Telegram - St John's, NL. SERPENT of the Deep. Kirk Squires, Transcontinental Media. December 11, 2006

The Packet, Clarenville, Newfoundland. SERPENT of the deep: Chevron's exploration finding more than oil. Monday Dec 4, 2006. By Kirk Squires

Chevron Retirees Association - Global Employee eMagazine. Line Rider Issue 10 (November 2006): Tails of the Deep.

The BP Magazine: Snapshots from the deep. Issue 3 2006.

Oil & Gas Journal: New projects develop in Canadian Maritimes. Week of Nov. 20, 2006

BP Horizon Magazine: Marine research - On the trail of the zombie worm. November 2006

Petroleum Africa: Using Oil & Gas Industrial Technology to Explore the Deep Seas. SERPENT makes a splash... October 2006

# Research Assistants & Students

**2006 saw continued opportunities for SERPENT Research Assistants, PhD and Masters students. An overview of some of the research carried out over the year is summarised here. The next year looks set to continue these exciting avenues of research, with scope for more research projects around the world.**

## Andrew Guerin

PhD: Artificial Reefs: Links to Oil and Gas Operations"

"In addition to being working structures, oil and gas production platforms in the North Sea function as artificial reefs. They provide a large area suitable for the settlement and growth of a variety of organisms, including mussels (*Mytilus edulis*), plumose anemones (*Metridium senile*), soft corals (*Alcyonium digitatum*) and the cold water coral *Lophelia pertusa*. In addition, several species of pelagic and demersal fish are attracted to the vicinity of the rigs, including saithe (*Pollachius virens*) and cod (*Gadus morhua*) as well as some species normally found around natural reefs, such as red-fish (*Sebastes* spp.) and torsk (*Brosme brosme*).

Project work has been focussing on the use of ROV footage to examine patterns in the fouling communities present on several North Sea platforms, using footage kindly supplied by TOTAL E&P, BP and Petrofac. Data cover three platforms of different ages located relatively close together at the northern part of the UK sector, as well as a few platforms in different locations, allowing investigation of the effects of age of platform and location on the composition of the fouling community.

This is in addition to data collected on three research cruises with FRS Aberdeen to investigate the changes in local biological communities resulting from the installation of a new platform in the Buzzard oil field (Nexen Inc.)."

## Claire Fletcher

Research Assistant, September 06 - January 07

"As part of the ongoing partnership between SERPENT and the Norwegian oil company Statoil, I have been working on data from six wells in the Norwegian and Barents Sea. The first stage of data analysis is to review ROV video survey footage taken surrounding each well. All benthic fauna are counted and recorded, and a map of impact on the sedimentary environment is created. Using knowledge of speed and the length of each survey transect, the proximity of fauna from the well centre can be determined. Data are recorded at oil wells at various stages during their development and lifetime. I have also been involved in the analysis of sediment samples retrieved from the seabed during site visits. Using the facilities at NOCS, I assisted in the determination of the total organic content of sediment core samples taken from around study wells. All of this information can then be combined to assess the impact of drilling activity on the deep-sea bed, and the timetable for a return to the pre-drilling condition."

## Sarah Murty

PhD: Application of Ecophysiology to the Deep Sea

"Over the past year I have been working with engineers from the National Oceanography Centre to improve the design of the benthic incubation chamber, which I shall use for part of my PhD research. The new design will be deployed offshore in May and June 2007. Alongside this work, I have been developing molecular techniques with a view to assessing how deep-sea organisms are affected by stress in their environment. This work has led to the successful design of three molecular "primers" which will be used to provide an indication of how the expression of three proteins; citrate synthase, heat shock protein 70 and ubiquitin changes with drilling fluid induced stress. "

## Gareth Andrews

Honours Project: The Nutritional Ecology of Sea Urchins: A Comparison between the Deep and Shallow Seas

"The nutritional ecology and nutrient limitations experienced by deep-sea and shallow water sea urchins were explored using a modelling approach developed to investigate the nutritional relationship between animals and their environment.

A technique was developed to investigate foraging behaviour and nutrient selection in the deep sea, involving choice arrays comprising agar-based food blocks of defined nutrient composition. Trialled in Bass Strait, South Australia (90m water depth), the array was deployed and filmed by ROV from the Maersk Guardian drilling rig. The array was then deployed from the Woodside Ocean Bounty drilling rig in the Mutineer development (146m depth), Northwest shelf, Western Australia. Feeding trials were conducted in experimental enclosures and on the open seabed. Nutrient selection behaviour of the deep-sea sea urchin *Diadema* sp. was monitored on the open seabed, revealing a preference for high-protein food blocks. When confined in feeding enclosures over 72 hours, this preference for protein shifted after 24 hours towards feeding mainly on blocks made from kelp and seagrass. This suggests that the urchins were protein deprived and were seeking to redress a nutrient imbalance. They then returned to a high-carbohydrate and plant-based diet. The trophic position of the sea urchins was calculated using stable isotope analysis, verifying their omnivory. Comparison was made with two abundant species of co-occurring shallow water Australian sea urchins. Omnivorous and herbivorous urchins both displayed a stable pattern of food selection over 72 hours, indicating that, unlike the deep-sea species, they were in nutritional equilibrium. In further tests in which the urchins were subjected to food limitations, only one urchin altered its nutrient intake to redress the imbalance."

## Iñigo Martinez, FRS Marine Laboratory

PhD: Temporal changes in the fish assemblage on a new oil platform in the North Sea

"Artificial structures have been used by fishermen throughout history as FADs (Fish Aggregation Devices) to concentrate and catch fish. Oil and gas subsea structures such as pipes, manifolds and platform jackets will act as FADs, providing fish with shelter against currents and predators, and opportunities for feeding. As encrusting fauna such as coral and anemones colonize the structures, they can act as artificial reefs, providing further benefits to fish and other marine life.

The aim of my project is to study the changing fish community around a newly installed platform in the North Sea and compare results with data collected prior to the construction of the platform, when the area was open to fishing. The Nexen-operated Buzzard platform has three sub-sea jackets supporting the wellhead, production, utility and quarters, along with two remote sub-sea water injection manifolds. Using a baited stills camera and ROV surveys where possible, I am aiming to address questions such as how the local fish species diversity, abundance and population structure is altered, as well as identify seasonal or diurnal patterns in the use of the platform as a 'reef' by different species."

## Dr Andy Gates

Research Assistant

"Since joining SERPENT in February 2007 I have been carrying out laboratory analysis of the core samples taken during ROV sampling from the Tornerose drilling site in the Barents Sea. The aim is to determine the effects of drill spoil disturbance on the abundance and distribution of the meiofauna around the well head.

I have also attended the BOSIET and OLF offshore survival courses in Aberdeen to enable me to visit the Transocean Rather rig, located west of Shetland. The purpose of this visit is to carry out pre-drilling ROV video surveys, collect further benthic samples including macro- and meiofauna, and to deploy experimental equipment for collection on the return visit"

# New Partnerships

## Apache Australia

A new collaboration between SEA SERPENT and Apache will see our team head out to the Van Gogh development, in the Exmouth area off Western Australia, in 2007.



venturing offshore to the Songa Venus at the Ichthys development in the Browse Basin, Western Australia. INPEX Browse, Ltd. has a total of eight projects in Australia, including four projects in offshore Western Australia and four projects in Victoria and offshore Tasmania. We therefore look forward to an active and successful relationship with INPEX in the future.

## Chevron

SERPENT has worked closely with Chevron all around the world over 2006 to develop partnerships with Chevron UK, Chevron Canada and Chevron Australia. We have carried out some very successful work in the deep-waters off Newfoundland deploying settlement experiments to investigate potential rates of recovery from disturbance - at the same time yielding some superb images of the deep-water animals and witnessing new depth records for some of the fish.



In UK waters, we started to plan work at the 1,200m deep water Rosebank/Lochnagar site in the Faroe-Shetland Channel. This gives us the rare opportunity of on site experimentation to begin to understand biological processes in this remote environment

SEA SERPENT's first project with Chevron Australia will see team members out on the Songa Mercur at the Wheatstone development in April 2007. Joint use of the Songa Mercur between Chevron and Santos means greater access offshore. We hope to expand our collaboration with Chevron Australia in the future, tapping into its geographical diversity and increasing our knowledge of the deep sea in Australia.

## Oceaneering

Our collaboration with Oceaneering deepened in 2006 to become a formal partnership. We will now work together to integrate SERPENT protocols into Oceaneering's training packages, and hope to roll-out SERPENT-based communications within the organisation to raise awareness of the project. We hope this will not only increase buy-in to SERPENT by Oceaneering's employees, raising awareness within the company of the fantastic variety of animals in the deep sea, but will also deliver more images and video footage to us that will allow us to identify future locations of research interest.



## Santos

SEA SERPENT has been collaborating with Santos for over two years, resulting in many successful offshore missions. Santos supported part of a student project in 2006, leading to an honours degree. This year, Santos have also committed to a three-year collaboration with SEA SERPENT that incorporates a PhD scholarship, and provides additional funding support to the project to help cover expenses incurred.



## CNR

A collaboration with CNR off the Ivory Coast has provided video from a pipeline inspection descending down the west African margin. This footage captured a rarely seen biological food-fall to the deep sea and is allowing us to quantify the mass deposition of large planktonic salps occurring in this area.



## Total

This year SERPENT started a project with the Total Foundation for Biodiversity and the Sea. This project will investigate the important larger seabed fauna of the Faroe-Shetland Channel and communicate the scientific findings within Total and to the general public. We carried out work at the Laggan site with Total E & P UK at the Laggan site, complementing research from the first Laggan mission and giving us an opportunity to revisit a site that has been subject to extensive, high resolution survey and assessing recovery in the two years between the visits.



## INPEX

SEA SERPENT will start working with INPEX in 2007,



# 2006/2007 Projects

## Faroe-Shetland Channel

The Faroe-Shetland Channel remains a hugely exciting area of research, and it is no surprise that SERPENT will be returning for further visits in the coming year. Our work will continue at the Rosebank site with Chevron UK, Transocean and Subsea 7. Further visits are also planned to the Laggan field with Total, and the Schiehallion and Foinaven fields with BP.

## North Sea

Research at the Nexen-operated Buzzard field will continue over the course of 2007. This work is enabled through a close collaboration between Fisheries Research Services, Marine Laboratory, Aberdeen, Newcastle University, NOC and a number of industry partners, and provides data and training opportunities for two PhD students.

## Norway

After a successful set of missions in 2006, SERPENT returns to work with Statoil at two new locations: Midnattsol and Ragnarokk. The enthusiasm from SERPENT, Statoil and Oceaneering is really driving this collaboration forward and plans are now also in place to set up a temporary exhibit at Stavanger's Petroleum Museum that can tour to other science centres and museums around Norway over the next couple of years.

## Australia

Significant new investments are allowing SEA SERPENT to start creating new opportunities and approaches to investigate deep-sea environments. Research is planned for the north west shelf of Australia (Enfield, Gorgon, and Perseus fields) and the Bass Strait (Otway and Casino fields) in collaboration with Santos and Woodside Energy Ltd. The Australian team are in the process of recruiting new members and acquiring and developing new tools to carry out this work.

## Venezuela

We will be working at the Statoil operated Orca well during the summer of 2007 in collaboration with the Universidad Simón Bolívar, Venezuela. This work looks particularly exciting not only because the study area offers great potential for exploration but also as we are able to strengthen our academic network with new science partners.

## Angola

The plans for the upcoming visits are in place with our project partners BP, Transocean and Total. We are hoping that capacity building will form a significant component of this project and that we can start creating some exciting new academic links with marine scientists in West Africa.

## Egypt

The deep-water locations in Egypt represent a great opportunity for SERPENT to work in the Mediterranean. This is another area that has received little or no previous ROV attention and we are looking to address this with Transocean and Shell in 2007.

## Barents Sea

We kick-started 2007 by conducting another mission to the Barents Sea at the Hydro operated Nucula well. SERPENT has started to characterise the seabed communities in this area in good detail and we are looking to build on this by carrying out further visits through our Norwegian connections.

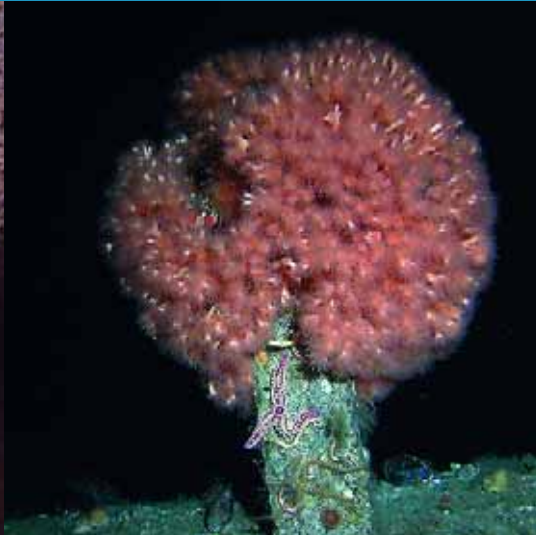
## Gulf of Mexico

SERPENT is in the process of making new links with the Repsol, and plans for this partnership are to take SERPENT back to the Gulf of Mexico in 2007. This would build on our previous very successful visits and add to the innovative work of Dr Mark Benfield at the Louisiana State University.

Top row, left-right: An anemone at the Brugdán Prospect, Faroe-Shetland Channel; a community in the North Sea; anemones and sea spiders on a mussel; an anemone attached to a rock at the Brugdán Prospect; a colony of *Lophelia pertusa* on a subsea structure in the North Sea; an abyssal grenadier, probably *Coryphaenoides leptolepis*, in the Orphan Basin



Bottom row, left-right: King crabs in the Gulf of Mexico (image courtesy of the BBC); coring at the Tornerose Prospect, Barents Sea; a chimaera rabbitfish, *Hydrolagus affinis*, in the Orphan Basin; a community attached to a riser in the North Sea; a ray, probably *Bathyrhaja spinicauda*, in the Orphan Basin; an anemone and sea spider at the Brugdán Prospect in the Faroe-Shetland Channel



# Our Partners & Collaborators

## Industry

BP (UK)  
Subsea 7  
Transocean

BP (Angola)  
BP (USA)  
Chevron Australia  
Chevron Canada Ltd.  
Chevron UK  
Kongsberg  
Nexen Inc.  
Oceaneering  
Santos Ltd.  
Statoil  
Total E & P UK  
Total Foundation for Biodiversity  
and the Sea  
Woodside Energy LTD

## Academic & Associated

Australian Museum  
BBC Natural History Unit  
Fisheries Research Services,  
Marine Laboratory, Aberdeen  
Louisiana State University  
National Marine Aquarium,  
Plymouth  
Newcastle University  
OceanLab, Aberdeen University  
Offshore Energy Centre, Houston  
Smithsonian Institute  
Society for Underwater  
Technology  
Texas A&M University  
Universidad Simón Bolívar,  
Venezuela  
University of Sydney  
University of Technology, Sydney  
University of Western Australia  
University of Wollongong  
U.S. Geological Survey

## SERPENT Advisory Panel

Chair: Dr Ian Hudson, Transocean  
Dr Penny Allen, BBC Natural  
History Unit  
Dr Mark Benfield, Louisiana State  
University  
Kelvin Boot, National Marine  
Aquarium, Plymouth  
Wendy Brown, Total  
Assheton Carter, Conservation  
International  
Dave Cawson, Subsea 7  
Bob Clark, Transocean  
Kristina Hardwick, GeoCet  
Ricky Holtom, Transocean  
Dr Emma Jones, Fisheries  
Research Services, Marine  
Laboratory, Aberdeen  
Ann-Marie McLaughlin, BP  
Arne Myhrvold, Statoil  
Peter Oliver, Chevron  
Dr Adele Pile, University of  
Sydney  
Cara Price, Woodside  
Karen Yorke, Nexen  
Sean Young, BP  
Dr Ben Wigham, Newcastle  
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