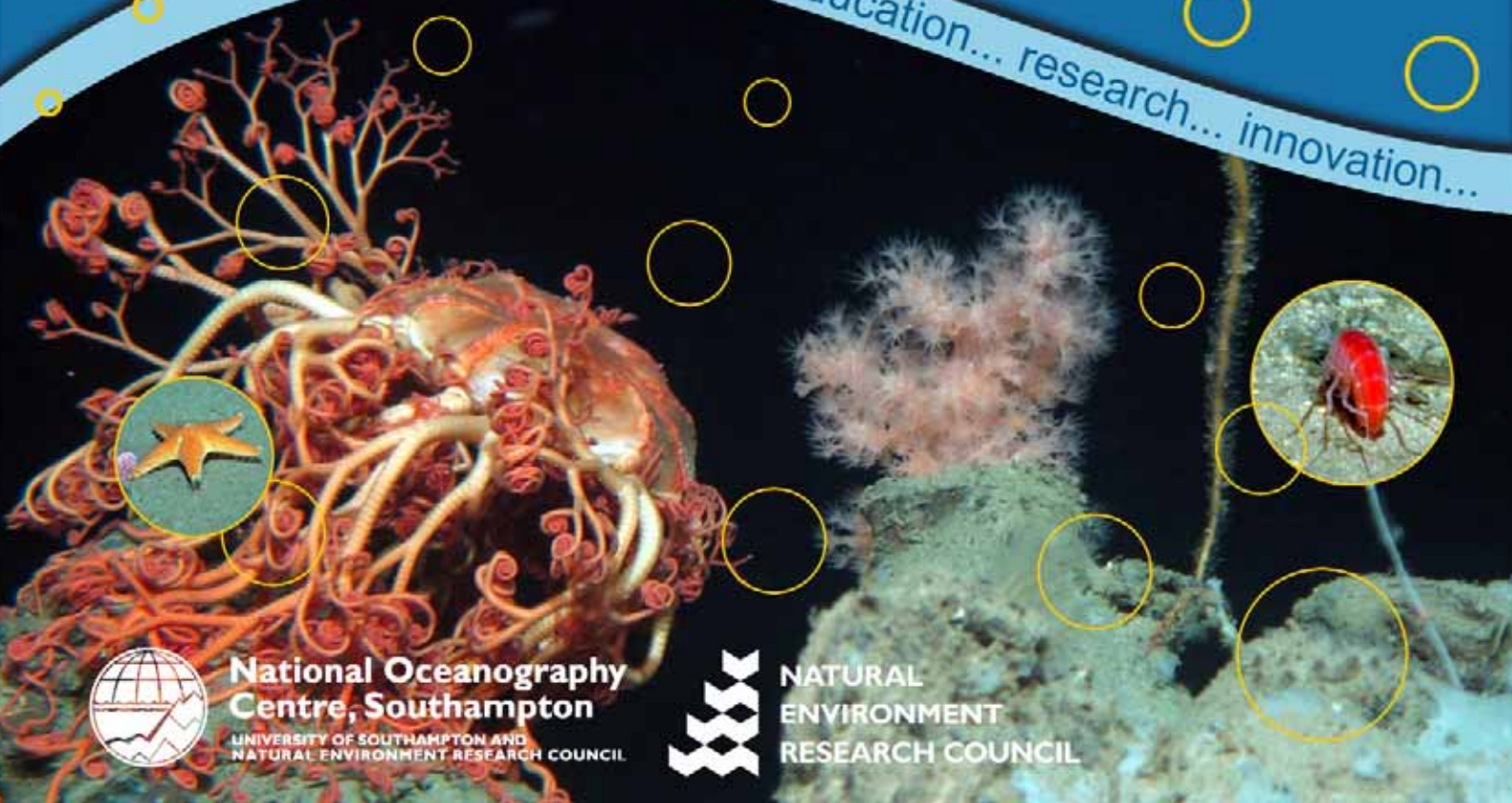


# annual report 2007

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



**National Oceanography  
Centre, Southampton**

UNIVERSITY OF SOUTHAMPTON AND  
NATURAL ENVIRONMENT RESEARCH COUNCIL



**NATURAL  
ENVIRONMENT  
RESEARCH COUNCIL**

# Foreword

2007 was an extremely busy year for the SERPENT project. We continued to carry out a high number of offshore missions, with thirteen rig and vessel based operations in 2007. A strong science plan has evolved with the project which is now delivering consistent and innovative research. Large volumes of high-quality data have been collected, which is being used to improve our understanding of the world's deep oceans and their marine life. This excellent research effort would not have been possible without the efforts of our partners and collaborators, and we extend our thanks to them, as always, for helping us to carry out such a full programme of works.

We have continued to integrate SERPENT into national marine science programmes in the UK, America and Australia through linkages to government sponsored research councils. These are the Natural Environment Research Council (UK), National Science Foundation (US) and the Australian Research Council. These projects will aim to develop fundamental deep-sea science in the region to underpin environmentally sustainable drilling practices. By working within these large research groups the SERPENT project can sit at the forefront of this research while being backed up by the largest body of marine science researchers in the world.

The year also saw some changes to our personnel; Dr Daniel Jones is now the SERPENT Project coordinator, also heading up the science in the UK. We welcome Dr Andrew Gates, who takes over from Janne Kaariainen as Statoil Hydro research fellow. We also welcome Rob Curry who takes over from Lis Maclaren as the SERPENT outreach coordinator. Dr Ben Wigham at Newcastle University continues to be closely involved in the North Sea SERPENT work. 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 2007, and we hope for more over the next year. The more global the reach 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 reading these highlights from 2007.

## The SERPENT Team

Cover picture: A stunning image from the Midnattsol dive in Norway. A magnificent gorgon's head basket star *Gorgonocephalus caputmedusae* competes for food with a nearby soft coral, from the order *Alcyonacida*.

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Cirrate Octopus *Cirroteuthiidae* from the Midnattsol field, Norway.

# SERPENT Team

## SERPENT Research Team

Dr Mark Benfield, Louisiana State University  
Dr Brian Bett, National Oceanography Centre,  
Southampton, UK (NOC)  
Dr Andrew Gates, NOC  
Dr Daniel Jones, NOC  
Dr Emma Jones, National Institute of Water & Atmospheric  
Research Ltd.  
Dr Adele Pile, University of Sydney (UoS)  
Dr Ben Wigham, Newcastle University

## SERPENT Outreach

Rob Curry, NOC

## SERPENT Research Assistants

Katie Pullen, NOC

## Collaborative Research

Dr David Bone, Universidad Simón Bolívar, Venezuela (USB)  
Dr David Booth, University of Technology, Sydney (UoT)  
Dr Juan J Cruz, USB  
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 (UoW)  
Dr Murray Thomson, UoS  
Memorial University of Newfoundland  
INIP - National Institute for Fisheries Research, Angola  
BCLME - Benguela Current Large Marine Ecosystem  
Census of Marine Life

## Associated Research

Dr Anthony Jensen, NOC  
Dr Chris Hauton, NOC  
Dr Lawrence Hawkins, NOC

## Graduate Researchers

Sarah Murty, NOC  
Tania Smith, NOC  
Joe Carolan, UoW  
David Cummings, UoS  
Ashley Fowler, UoT  
Andrew Guerin, NOC  
Iñigo Martinez Saez del Burgo,  
Fisheries Research Services, Aberdeen, UK





A stunning group of feeding basket stars *Gorgonocephalus caputmedusae* perform for us on an undersea stage.

## 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 human-induced change in the deep sea
- Communicate key marine issues to regulators & industry
- Develop experimental approaches to deep sea science
- Inform the public about the deep-sea environment
- Encourage best practice during offshore activities

# Where do we work?





SERPENT research in UK waters continued at full pace in 2007 and we are continuing to gather some really good data sets. Work around the Buzzard platform using baited camera techniques is continuing to provide North Sea research opportunities for two PhD students, Andrew Guerin and Iñigo Martinez.

## North Sea: Buzzard Project

Mission Partners: Nexen Inc., Fisheries Research Services, Marine Laboratory, National Institute of Water & Atmospheric Research, New Zealand, Newcastle University, Film-Ocean Ltd, Aberdeen

2007 was a busy year for the Buzzard SERPENT Project in the North Sea and extensive sampling provided a major boost to our ongoing scientific goals. At the new NEXEN Buzzard field, SERPENT scientist Iñigo Martinez and fishing gear technologist Iain Penny of the Fisheries Research Services (FRS) Marine Laboratory in Aberdeen have been monitoring the changes in the fish assemblage from free trawlable ground to the restricted 'no-anchor' exclusion area resulting from the construction of Nexen UK's newest asset in UK waters. They are using two techniques to survey fish communities; ROV (remotely operated vehicles) and BUC (baited underwater camera). Both these techniques provide underwater video and digital still images to study the fish community living *in situ* around the structures without actually having to "fish".

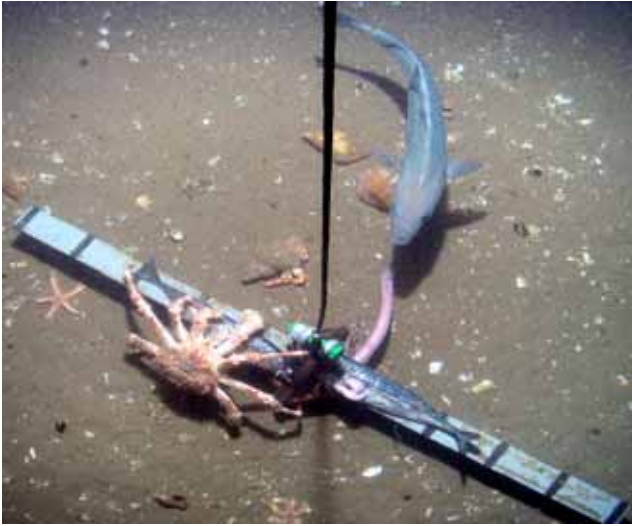
As well as sampling at the platform, the team has carried out baited camera surveys at a "control" site where they can also use more traditional survey methods such as otter and beam trawls. This allows a comparison of these different techniques and provides a way of relating the results from the visual methods with trawl surveys over the whole of the North Sea. The FRS Marine Laboratory has included the Buzzard site on the annual IBTS (International Bottom Trawl Survey) of the North Sea providing at least 2 tows per year building on a baseline data set initiated since 2004.

In total, five sampling missions have been achieved. In April our baited camera was deployed for the first time from the Wellhead platform deck, directly within the footprint of the structure. Shortly after, a baited camera survey was completed around the perimeter of the 500m excluded area and at the "control" site from the MFV Prowess chartered by the FRS Marine Lab.

.Sunset at Buzzard field during an April 2007 sampling cruise. Photo: FRS, Mike Steward.







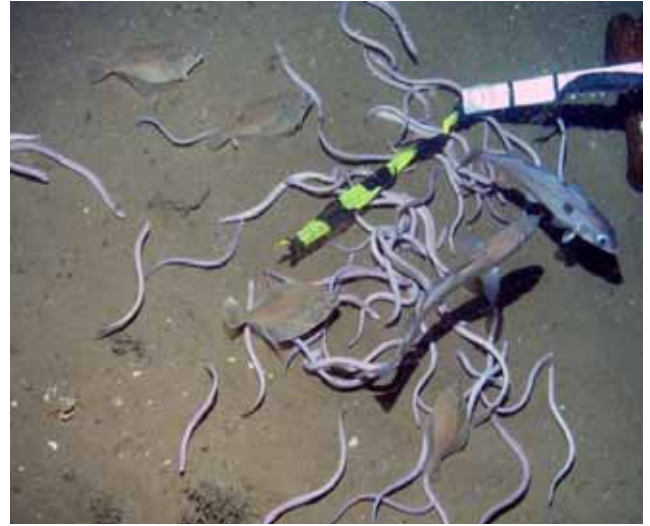
Invertebrates, hagfish, saithe and a hermit and spider crab attracted to baited camera on the footprint of Buzzard platform on October 2007. Photo: Iñigo Martinez.

These data have greatly enhanced our temporal data set, highlighting trends in density and occurrence of some of the most abundant species around the Buzzard area.

For the first time we participated on two ROV inspection cruises aboard the Fugro-Rovtech ROV vessel *Highland Eagle*. In June an inspection of pipelines at the Buzzard field and in October a jacket inspection allowed us to evaluate several techniques for assessing fish numbers and biodiversity, working closely with the pilots and adapting these to the time available with the vehicle and other vessel work activities. We have developed workable protocols to take forward into the intensive 2008 sampling period.

Methods tried during these and a third trip onboard ROVSV *Seisranger* (courtesy of SERPENT partners Shell and Subsea7) included parallel transects along pipelines and around the footprint of the platform at different distances from the pipeline and from the jacket structure, a survey of the water column with transects up and down the structure and Stationary Visual Surveys (SVS), adapted from methods designed for use by divers to survey coral reef fish.

Along with the standard inspection surveys, this ROV footage has provided valuable new insights into the most cryptic and conspicuous species living underneath the platform; rays (Fam. Rajidae), monkfish (*Lophius piscatorius*), and dragonet (*Callionomus* spp.) along with ling (*Molva molva*), found mainly associated



Haddock, whiting, hagfish, and flatfish attracted to bait at Buzzard platform. Photo: Iñigo Martinez.

with pipelines and link-log mattresses, and in the mid-water large, dense schools of saithe (*Pollachius virens*) associated with the jackets. In total 11 different fish species were observed in ROV footage of which 6 were also observed on the baited camera photographs.

Sampling is expected to ramp up even further in 2008 with the implementation of a new LAunch and Recovery System (LARS) designed by new collaborator Film-Ocean Ltd of Aberdeen that will allow both an Seaeye Falcon ROV and the BUC to be deployed directly from the platform without relying on the use of cranes and deck winches. An ambitious programme of work is planned from the platform itself and aboard the stand-by vessel VOS *Lismore* to collect comparative data from inside and outside the 500m safety perimeter.

These combined sampling programmes should allow the SERPENT team to assess not only the changes that have taken place since the platform was constructed, but also the change in the faunal community along a gradient of influence away from the structure. Repeat surveys at different times of the year, will look at the seasonal use of the platform and the overall goal is to gain a better understanding of the role of oil platforms as functional habitats and the dynamics of fish populations associated with them.

Enquiries to Iñigo Martinez, FRS Marine Lab, i.martinez@marlab.ac.uk

## West of Shetland

Whalebone Settlement

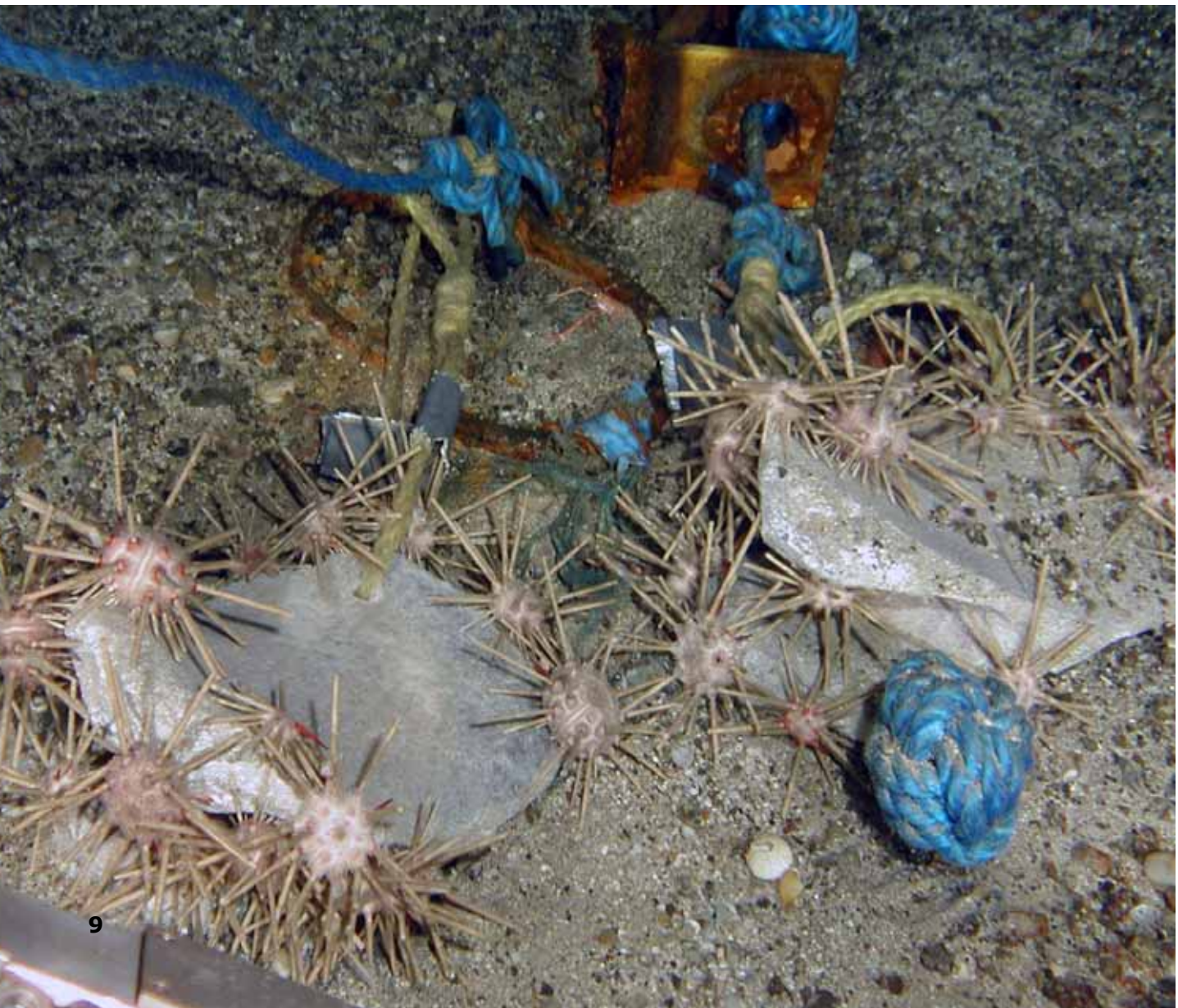
Mission Partners: BP, Transocean, Subsea 7

In 2007 we got the first results from our project investigating the colonisation of whale falls in the deep sea in collaboration with Dr Adrian Glover from the Natural History Museum, London, and Thomas Dahlgren of Göteborg University, Sweden. Working with BP, Transocean and Subsea 7, SERPENT organised in 2006 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. We wanted to study the whale bones over time for evidence of colonisation. We were expecting to find colonisation by a 'zombie worm', so called for its habit of burrowing into bone to feed.

When we re-visited the bones in June 2007 we found a surprising scene, instead of being covered in worms, large parts of the bones had been devoured by pencil-spine urchins. We did not know that these urchins would feed in this way and process bone material so quickly, an unusual and extremely interesting find.

In the North Atlantic, natural whale-falls are likely to be common thanks to populations of minke and sperm whales migrating to and from the Arctic, however they have not been studied. 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.

A surprising find (below) - Pencil urchins, not 'Zombie worms' were the surprise diners on the whalebones we left on the sea floor in 2006.



The delicate tentacles of this pair of hydroids *Tubularia sp* are streaming in the undersea current. Note the two small light coloured amphipods on the lower hydroid.

## Rosebank

In 2007 SERPENT Scientist Dr. Andrew Gates visited the Transocean Rother as part of a Chevron UK drilling programme at a number of wells within the Rosebank Lochnagar field at around 1100m water depth in the Faroe Shetland Channel (FSC). Over three visits during the year a good relationship developed between SERPENT and the rig staff from the respective project partners; Chevron, Transocean and Subsea 7 leading to valuable contributions from the observations made by the ROV crews both during and between the SERPENT visits.

In addition to the video surveys normally taken as part of a SERPENT visit a number of other good scientific samples were collected, with different visits focusing on different aspects of the deep sea biology of the FSC. Experiments were carried out to assess the rates of bioturbation, the reworking of the sediment on the seabed by burrowing organisms, important in the recovery process following disturbance from drilling operations. As part of a new collaboration with Professor Bill Keevil working in the School of Biological Sciences at Southampton University, frames were deployed to assess the colonization of subsea surfaces by biofilms – complex matrices of microorganisms that are known to grow on most surfaces but rarely studied in deep water. A detailed sampling programme was carried out to assess

the effects of drilling on the smaller organisms found within the sediment (the meiofauna) on the seafloor.

The Faroe-Shetland Channel supports a wonderful diversity of life. At Rosebank many fascinating observations were made ranging from large rays gliding over the seabed in search of food to the bizarre carnivorous giant club sponge. One of the advantages of the continuous collaboration with Chevron was that it enabled plenty of time to collect high quality photographic records of the species observed using the Kongsberg digital stills camera installed on the ROV for the Rosebank programme. These images are an important resource to SERPENT to aid in the identification of organisms seen in video surveys, to continue to document the distribution of rarely seen organisms and to provide valuable material for outreach and promotional activities.

# Gulf of Mexico

Mission Partners: BP, Chevron, Sapiem-America, Subsea7, Minerals management Service, Marine Advanced Technology Education Centre

SERPENT in the Gulf of Mexico (Gulf SERPENT) is coordinated by Mark Benfield within the Department of Oceanography and Coastal Sciences at Louisiana State University (LSU). While we are interested in all aspects of the biology of life in the depths of the Gulf, our primary focus is on the organisms that inhabit the water column. We are particularly interested in learning more about the poorly-understood fish and invertebrates that inhabit the waters below 200m in the mesopelagic and bathypelagic zones. Since the project's inception in 2006, we have continued to assemble a unique database of the spatial, depth, and temporal distributions of deep-sea marine life in the Gulf. Over time, we will use this information to understand where animals occur spatially and seasonally, what their depth ranges are, and what behaviors and associations with other animals occur.

The past year has seen significant developments in the Gulf SERPENT program. In the fall we began the first of three years of funding from the Minerals Management Service (MMS) via the LSU Coastal Marine Institute. MMS is an agency within the U.S. Department of the Interior with oversight on oil and gas activities in the U.S. exclusive economic zone. Our MMS grant will ensure that Gulf SERPENT has the resources necessary to maintain an active research program through to 2010.

We have continued our very successful partnership with BP and by the end of 2007, we had visited and obtained commitments to collect SERPENT data from three BP deepwater facilities: the drillship Discoverer Enterprise, Thunder Horse PDQ and Mad Dog Spar. Our operations at Thunder Horse and Mad Dog are also notable because they mark

the first time that we began working with ROVs operated by Saipem-America (formerly known as SonSub).

Identification of the marine life the ROVs observe depends on the highest quality imagery possible. While the standard cameras on the ROVs can produce some very nice footage, the resolution of these images is frequently too low to determine what species are in view. Higher resolution cameras are essential. Last year, BP made a commitment to fund acquisition of a high-resolution camera system for use on participating ROVs. At the time of writing, BP had donated \$30,000 to Gulf SERPENT to acquire a high-resolution digital still camera and strobe for our research. With the generosity and assistance of Oceaneering, we look forward to acquiring a new 8 megapixel camera and strobe system from Deep-Sea Systems — a subsidiary of Oceaneering. This is the same camera that has been used with great success by NOAA during surveys in the Arctic Ocean using the Global Explorer ROV.

Negotiations with Chevron have been ongoing through 2007. In the fall of 2007 we began to collect data from the Transocean drillship Discoverer Deep Seas (DDS). There are two aspects to our research at the DDS. We are part of a research project coordinated by the Subsea Intervention Team within Chevron's Deepwater Technology Company. This project is evaluating a dynamic positioning system for the ROV. This system has the potential to provide a precise geographic location for each organism. In January 2008, Mark Benfield visited the DDS to work with the Subsea7 ROV team and familiarize them with our water column survey protocols. This is the first time that we've worked with Subsea7 and their cooperation has been outstanding.

In addition to our partnerships with BP, we have been in contact with both BHP Billiton and Shell regarding their participation in Gulf SERPENT. We look forward to expanding our partnership with these firms during 2008.



A manefish *Caristius sp.* observed beneath the Ocean Confidence. The ROV obtained almost 6 minutes of incredible video of this rarely seen fish. In fact, this appears to be the first observation of a live manefish in the Gulf of Mexico and the best underwater footage of one seen anywhere.

The past year has also been productive from the perspective of education and outreach. The Marine Technology Reporter showcased Gulf SERPENT on the cover and in a feature article within its September 2007 issue. The March issue of Well Connected — BP's in-house drilling magazine also carried an article on our program. That same month, United Airlines' Hemispheres in-flight magazine devoted its science and technology section to a feature about SERPENT and other research at offshore petroleum facilities in the Gulf.

Scientific communication included oral presentations at Underwater Intervention in New Orleans during January and at the 2007 ICES Science Meeting in Helsinki, Finland during September. In addition, Tanya Ribakoff who was our MATE summer intern in 2006 presented the results of her work at an American Fisheries Society Meeting in Florida during February. The scientific journal: Bulletin of Marine Science published a research article on our discovery of a large sleeper shark in the Gulf of Mexico, and



Matthew Zucker, a grade three student at Hunter College Elementary School in New York City, decorates a Styrofoam cup for a Gulf SERPENT learning exercise about the deep sea.

another article on observations of a Manefish has been submitted for review in another journal.

Education remains an important aspect of Gulf SERPENT operations. In November we partnered with the grade three classes at New York City's Hunter College Elementary School for a teaching exercise to study the effects of pressure in the oceans. Students decorated large Styrofoam cups, which were transported to the bottom of the Gulf by the Oceaneering ROV team aboard Discoverer Enterprise, where they were compressed to the size of shot glasses. A video documenting the study and summarizing how Gulf SERPENT operates were enthusiastically received by the students. Later in the year, children from the Louisiana State University Child Care Center decorated cups for a similar project, once again with the cooperation of the Discoverer Enterprise ROV.



A midwater squid (*Octopoteuthis sp.*) eyes the Oceaneering© ROV beneath the Transocean Discoverer Enterprise.



We're interested in everything from snails to whales. On the small end of our observations was this heteropod imaged beneath the Thunder Horse PDQ.



On the large end of the size spectrum we study was this sperm whale who visited the ROV beneath Discoverer Enterprise during September 2007.

Education (MATE) Center to recruit an undergraduate summer student intern. The success of that internship encouraged us to once again have an opportunity to provide a talented undergraduate with a unique educational opportunity.

2007 proved to be a very successful year for our program with the addition of new partnerships and study sites. 2008 promises to be a pivotal year for Gulf SERPENT. We have hired our former undergraduate student worker – Marianne Alford as a technician to assist in processing video data. We will add new partnerships to our collaboration with industry, expand our geographic coverage of the northern Gulf, acquire new high-definition observational capabilities, and gain new insights into the ecology of a region that we know so very little about. Our greatest challenge is achieving a sustained data collection flow from our offshore sites but we are confident that Gulf SERPENT is moving towards achieving our objective of establishing a unique, deepwater, biological observing network in the Gulf of Mexico during September 2007.



Close up of a basket star *Gorgonocephalus caputmedusae*.

## Norway

In 2007 SERPENT had exciting opportunities working with Statoil (now StatoilHydro) to carry out detailed surveys of deep and shallow water sites off Norway. A wide variety of scientific studies were made and a spectacular diversity of marine life observed.

### Midnattsol

Mission Partners: StatoilHydro, Transocean, Oceaneering

At the Midnattsol well, 130 km west of Kristiansund, Dr. Andrew Gates visited the Transocean Leader before and after drilling to assess the effects of the disturbance on the seabed environment. Working with the Oceaneering ROV team a range of methods were used, including video transects to quantify the abundance of the larger animals around the well, push core sampling to determine the chemical make-up of the seabed as well as experimental approaches to study important processes involved in the functioning of deep sea ecosystems.

Life was abundant at this site despite the kilometer of water depth and seabed temperature of  $-1^{\circ}\text{C}$ . The seafloor was characterized by a vast numbers of sabellid polychaete worms, removing suspended food particles from the water column and providing SERPENT scientists with a useful indication of the extent of the drill cuttings pile. However the most spectacular organisms were the basket stars (*Gorgonocephalus* sp.), with their highly branched arms extended to catch food particles from the water flow and the impressive *Umbellula* sp., a two metre high, Cnidarian common in the area.

### Ragnarokk

Mission Partners: StatoilHydro, Seadrill, Oceaneering

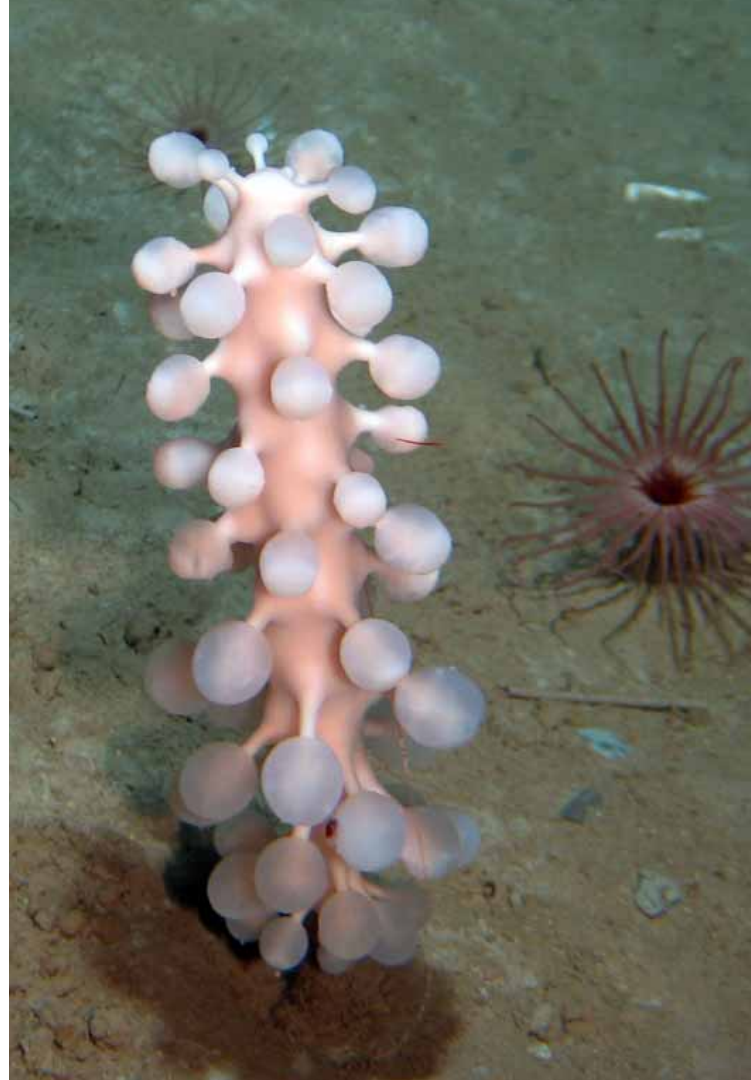
The Ragnarokk well, at 110m water depth was shallower than typical sites for SERPENT operations. It was located southwest of Stavanger in the North Sea. SERPENT made two visits to the jack-up rig, West Epsilon at



the site in the summer of 2007. Early in the summer Andrew Gates worked with the Oceaneering ROV team to conduct the pre-drilling survey, which included video transects and sediment sampling. During this visit it was noted that there was a high abundance of *Echinus acutus* sea urchins living on the seabed. This is valuable information for SERPENT scientists and along with the shallow water enabling much reduced ROV transit time between the rig and the sea-bed, provided the opportunity to plan detailed experimental work for the follow-up, post-drilling visit.

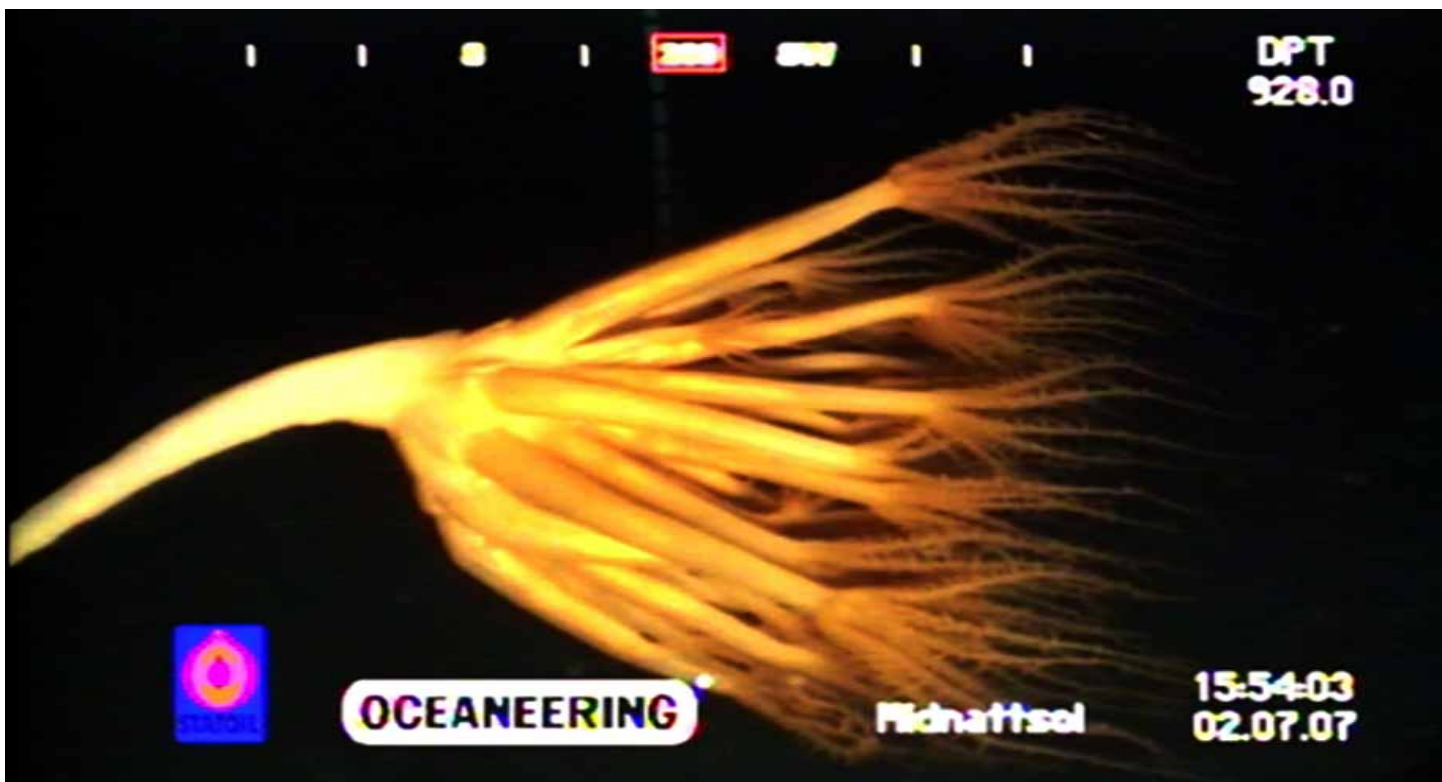
Daniel Jones returned to the West Epsilon towards the end of the well for the post-drilling visit. In addition to repeating the sediment sampling and video transects he also used the precise capabilities of the ROV manipulator arms to carry out a series of experiments to assess the impact of drill spoil accumulation on the dominant organisms in the area. Specimens of the abundant sea urchins were subjected to a series of manipulations involving placing them under piles of sediment. Behavioural responses were observed and tissue samples were taken to test molecular indicators of the stress response.

Such experimentation is important in gaining a more complete understanding of how the accumulation of drill spoil impacts the benthic ecosystems around drilling operations.



Above: A giant club sponge *Chondrocladia gigantea* found living on soft sediment at depths of 240-1600 m.

Below: *Umbellula* sp. A 2m tall Cnidarian common in the area.



# Venezuela

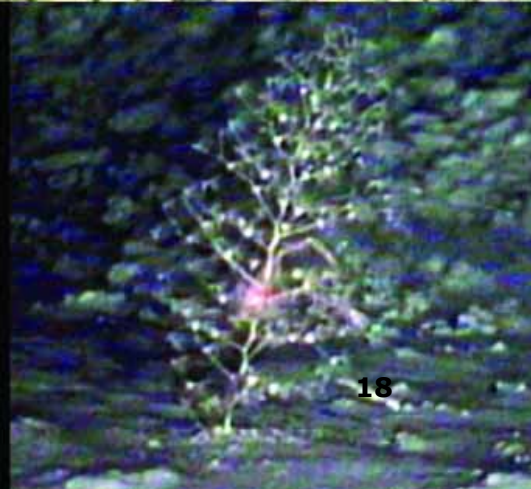
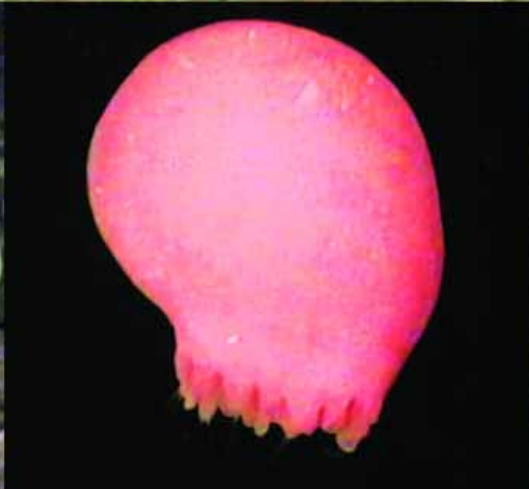
SERPENT scientist Dr Daniel Jones carried out a successful expedition to investigate the deep-water fauna of the biologically unknown offshore region to the northeast of Venezuela. The visit targeted the Orca field, a hydrocarbon exploration area for Statoil (now Statoil Hydro) in 545 m of water in the Orinoco fan – an area heavily influenced by sedimentation from the Orinoco river, one of the longest in South America. Knowledge of the biology of offshore Venezuela extremely poor, essentially limited to SCUBA diving depths (around 30 m), with absolutely no biological investigations of the entire bathyal region (depths of 200 to 2000 m) until now. Working in collaboration with the Universidad Simón Bolívar in Caracas, SERPENT scientists used remotely operated robotic submarines to explore the diversity and density of the seabed communities at Orca and to find out the effects of exploratory drilling on this relatively pristine ecosystem.

At Orca, although not densely populated, the seabed had a range of unusual, often colourful animal life including abundant solitary corals, large, flowerlike tube anemones and the ancient stalked crinoid, once incredibly abundant, now only found in the deep oceans of the world. A range of strange fish were seen including a flattened, bright-orange anglerfish and an as yet unidentified fish with modified fin rays splayed out around its head presumably to sense its surroundings in this perpetually dark environment. A ROV operated scoop was used like a butterfly net to catch these denizens of the deep and bring them to the surface for detailed microscopic investigation. We also deployed a series of traps, designed to catch the common scavenging fauna, these animals rapidly take advantage of large food falls to the deep, often gorging themselves until they cannot move. A tuna bait was particularly effective catching the slimy hagfish – who can produce several litres of slime an hour, and most excitingly the giant isopod. This creature is very closely related to the common woodlouse but has undergone, in evolution, a process of gigantism in response to limited food availability in the deep-sea and is now observed to nearly half a metre in length! These specimens will form the basis of a deep-sea collection of preserved fauna for future work by Dr David Bone and Dr Juan Cruz at Universidad Simón Bolívar.

Dr Daniel Jones gets up close and personal with the giant isopod, *Bathynomus giganteus*



Below: A medley of selected videograbs shows the diversity of the benthic environment. Note the unusual array of modified fins on the Blackfin spiderfish *Bathypterois phenax* bottom left.



# Australia

## Industry supported scholarships training next generation of scientists

The strength of SEA SERPENT is based on successful partnerships with the oil and gas industry, and the collaboration between the Universities of Sydney, Western Australia, Wollongong and University of Technology, Sydney. Recognising the need to train the next generation of scientists and to accelerate regional capacity building, Santos and Woodside are supporting 17 scholarships over the next three years within SEA SERPENT. The scholarships are integral part of the agreement with Santos and Woodside Petroleum, and the companies themselves insisted on providing these scholarships, which they view as an effective and useful tool for developing an educated future workforce.

In 2007 SEA SERPENT expanded its engagement with the industry by signing agreements with Chevron and Apache Energy, for work from 2008, and is at present in the process of finalising an agreement with INPEX.

To date, we have graduated two SERPENT honours students from the University of Sydney, Katie Robertson and Gareth Andrews. At the 2007 annual meeting of the Australian Marine Sciences Association (AMSA), Katie was awarded AMSA's most prestigious prize, the Ron Kenny Award for Best Poster Presentation, for her research into the whether deep sea animals inhabiting drilling sites exhibit physiological stress. Katie's research was supported by Woodside Petroleum and conducted on the Jack Bates during the Enfield development. Gareth Andrews was awarded the William John Dakin Memorial Prize in Zoology for excellence in the subject of Zoology to a student gaining first class honours in Biology, from the School of Biological Sciences, University of Sydney, for his paper on the nutritional ecology of sea urchins. Gareth's research was supported by Santos and completed during a drilling campaign at Mutineer on the Bounty.

The excellent relationship with Santos and Woodside Petroleum continues to allow offshore visits by SEA SERPENT researchers to the Northwestern shelf of Western Australia.

Examples are a visit in September, by a University of Sydney team member to Santos' Mutineer 13 field, which was a highly successful mission resulting in 7 days of ROV operations involving 12 dives, and allowing us to obtain six 80 m video transects. And again in October, a visit by two other University of Sydney team members, including SEA SERPENT's project coordinator Dr Adele Pile, to the Mutineer 13 field, during which there were 5 days of ROV operation, yielding over 12 hours of footage.

## Natural pharmaceutical products from the deep sea?

Australia's deep-sea fauna (>100m depth) are unexplored in terms of their natural products chemistry due to the difficulty of accessing deep-sea samples. Through the SEA SERPENT program, the natural product research team at Wollongong University, led by Dr Danielle Skropeta, has gained access to a range of Australian deep-sea fauna, including sponges, anemones, echinoderms and crustaceans. The biological activity of small molecule inhibitors isolated from these deep-sea fauna are currently being examined as the team aims to harness the pharmaceutical potential of deep-sea natural products as prospective new anticancer and antiviral agents.



These extracts may hold a future cure for cancer.



A student attempts to use "robotic claws" during the Community Outreach event.

## Compact Light Trap trialed

SEA SERPENT has recently finished shallow-water testing of a new compact light trap capable of catching invertebrate zooplankton and fish larvae at depths of up to 3000 m. The trap uses power-efficient digital LEDs, capable of being programmed to emit a range of frequencies and levels of brightness, instead of the conventional analog fluorescent tube. These traps will provide data on the settlement of reef-fish surrounding oil rigs at previously un-sampled depths, and hopefully increase our understanding of recruitment processes to these unique systems.

## Community Outreach Day at the University of Sydney

In April 2007, 70 students from years 10 to 12 from local schools visited the University of Sydney to participate in a series of lectures and workshops put on by the Physics, Biology and Chemistry departments. Biology day included an "Investigating the Ocean with Robots" activity, produced and run by SERPENT team member Dr Adele Pile and Dr Stefan Williams from the Australian Centre for Field Robotics.

Students were shown footage of Adele's undersea investigations and heard how on one occasion she had to scrounge for materials only found on the oil rig in order to quickly make a device for catching eels. The task was set; in groups of three or four, the students created eel-catchers with an aim of collecting as many 'eels' - plastic fish - as possible from a testing tank. The materials provided included steel collanders, metal spoons, plastic buckets, milk-crates, gaffa-tape, rope, PVC piping and netting. The objective was to manipulate their constructions with two toy robotic claws, with the added challenge that the driver could not see what they were doing but had to rely on someone issuing them with instructions.

There was a great deal of creativity shown by many of the groups, each having to explain their design to the class. In the end, the most successful solution was found to be the simplest - a net, similar to a butterfly catcher.

A pair of Dusky Flatheads *Platycephalus fuscus* captured by the new light trap



# Outreach & Education

## New Outreach Coordinator

Lis Maclaren left SERPENT in October of 2007 at the end of her contract period. We are hugely indebted to her for her tireless and innovative work in promoting the interests of SERPENT over the last two years and she will be greatly missed. On 3 Feb of 2008, Rob Curry took on the role of Outreach Coordinator, and is eager to continue and expand on all the great work done by Lis during her tenure. If you have any comments or suggestions he would be very happy to hear from you at [r.curry@noc.soton.ac.uk](mailto:r.curry@noc.soton.ac.uk) or by phone on +44 2380 596357.

## 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.



## Website

The website is constantly updated and developed with the latest information about the project, images and videos. We are continuing to get approximately 2,000 visitors a month to the website, each visiting on average four pages. Coverage is global (visits from 128 countries), with hotspots in the UK, Australia, United States, Norway and Japan. The SERPENT website has been selected to be archived by the British Library as part of their web archival programme.



## Image and video database

The new image and video database developed during 2006 has been highly successful in its first year, partly due to the ease with which information can be added. It has been regularly used to record species observations and is proving to be very easy to use for visitors as well. The introduction of the archive has ensured that the SERPENT Project continues to offer an extremely valuable resource for scientists and the public alike. Further developments are in the pipeline, including adding a link with Google Earth to pinpoint where various animals have been found.

## Media

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 Landward Programme and the "Nature of Britain" series. We have also had a lot of exposure in print media, the details about our general interest and scientific publications can be found in the Publications section.

## Events

### *Royal Society Summer Science Exhibition*

The SERPENT project presented a very successful exhibit at the prestigious Royal Society Summer Science Exhibition. We were very pleased to be selected for the exhibition which showcases the best of British science each year. The event was hosted at the Royal Society's Carlton House in London for a week in July, and attracted nearly 5000 visitors including captains of industry, members of parliament, media personalities, senior scientists, schools groups and members of the public. The Royal Society is the national academy of science of the UK and the Commonwealth. It has supported projects at the cutting edge of scientific progress since its formation in 1660.



Dr David Billett (left) with members of the SERPENT team and the popular VideoRay™ mini ROV at the Royal Society Summer Science Exhibition.

### 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.

### Linnean Society of London

Dr Daniel Jones was an invited speaker at the Linnean Society of London as part of the high-profile celebrations for the tercentenary of Linnaeus. The lecture focused on the parallels between SERPENT and Linnaeus, both using the high-technology of the day to access remote places and make new biological discoveries.

### National Science & Engineering Week

The British Association for Science holds an annual week-long event in March to promote science to all ages. A series of events and open days allow children and adults alike to come and meet scientists, listen to talks and take part in science-based activities. This year, the National Oceanography Centre held another successful Ocean and Earth Day, with over 1,200 visitors. SERPENT had a large exhibit at the day, with hands-on activities for kids as well as giving talks.

### International Association of Drilling Contractors Environmental Conference

The SERPENT team gave a number of talks and had a popular exhibit at this years International Association of Drilling Contractors conference in Amsterdam. The event was a useful way of updating the industry on our latest developments, ensuring good knowledge transfer for our research and also allowing us to make new contacts and re-energise existing relationships.



Lis Maclaren talks to an interested visitor.



# 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*. 151: 1731-1741
- Jones, D. O. B., Bett, B. J. and Tyler, P. A. (2007) Megabenthic ecology of the deep Faroe-Shetland Channel: a photographic study. *Deep-Sea Research Part I*. 54: 1111-1128
- Jones, D. O. B. (in press) Using existing industrial remotely operated vehicles for deep-sea science. *Zoologica Scripta*.

### Non peer-reviewed publications

- Jones, D. O. B., Kaariainen, J. I., Maclaren, E. K., Robertson, K., Pile, A. J. and Hudson, I. R. (2007) SERPENT Cruise Reports July 2002 to December 2006. National Oceanography Centre, Southampton Cruise Report Series No. 17. 248 pp.
- Guerin, A. J., Jensen, A. C. & Jones, D. O. B. (2007) Artificial reef properties of North Sea oil and gas production platforms. *Oceans '07 Proceedings*, Aberdeen, Scotland. 18-21 June 2007.
- Benfield, M. (2007) SERPENT - Industry and Academia Team-up to Explore Marine Life in the Gulf of Mexico Deepwater Region. *Marine Technology Reporter* September 07.
- Anon (2007) Project SERPENT is a brilliant scheme! *Maritime Plymouth Newsletter* Sept 2007.
- Campbell, H. (2007) Discoveries of the Deep. *BP Magazine*
- Mathismoen, O (2007) Fisk og sjøstjerne bryr seg ikke. *Aftenposten* (Major Norwegian Newspaper) 30 Jan 2007

# Research Assistants & Students

**2007 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.**

## Tania Smith

PhD: Sexual Chemistry in the Deep Sea

I have just completed (and passed!) my PhD research project entitled "Sexual Chemistry in the Deep Sea". This project focused on deep-sea sea cucumbers because they are the most abundant big animal living on the sediment surface in the abyssal deep sea.

My results showed that the chemical composition of the ovaries of deep-sea sea cucumbers - found 4000m below the sea surface - was dependent on the amount and composition of the dead phytoplankton arriving at the sea floor. The magnitude of this influence differed between species, so that in certain conditions, specific species would benefit by having the right diet to optimise the chemical composition of their ovaries and therefore produce lots of healthy offspring. This is important, as such conditions may initiate community changes, which will affect the rate at which carbon is processed and therefore buried into deep-sea sediments.

I would like to thank BP for their support in being my funding CASE partner. The SERPENT project also gave me invaluable offshore experience, which was most rewarding and educational.

I look forward to working with the SERPENT project in the future as I think the project offers unique opportunities to carry out research in the deep-sea environment.

## Katie Pullen

Research Assistant

I spent Summer 2007 in the laboratory at NOC analysing ROV core samples that had been sieved to 180  $\mu\text{m}$ . These had been taken from Tornerose in the Barents Sea, one of the SERPENT Sites in 2006. This was to see the effect that an exploratory oil platform has on the benthic nematode community, and involved looking at how abundance, body size and functional groups changed with distance from the disturbance.

Size spectra were created, which revealed an interesting result - I found that larger specimens were prevalent close to the drilling site and there were smaller ones further out. To try to gain an understanding of the ecological adaptations to the environment, I decided to choose the the head and tail types as the functional groups to investigate.

I am currently looking at the smaller 90  $\mu\text{m}$  size fraction to arrive at a more comprehensive data set.

## Sarah Murty

PhD: Towards Deep Sea Ecotoxicology: Experimental Approaches with Echinoid

"Over the past year I have deployed the new benthic incubation chamber 2 in the North East Atlantic during a HERMES research cruise to the West Iberian Margin.

Measurements of brittle star (*Ophiura irrorata concreta*), sea cucumber (*Zygothuria lactea*) and star fish (*Psilaster cassiope*) oxygen consumption rates were made - for the first time with these deep sea species.

In addition to this work, I have continued to develop molecular gene expression techniques with a view to assessing how drilling fluids affect sea urchins."

## Andrew Guerin

PhD: Artificial Reefs: Links to Oil and Gas Operations

Artificial reefs can act as habitat for diverse communities of marine species, and these communities may eventually become very similar to those on natural reefs. Fouling species include mussels, oysters, hydroids, anemones, algae, hydroids, and even some corals. Artificial reefs also attract mobile species such as crabs and whelks, as well as fish, which may use these reefs as a source of food or shelter.

Project work is currently focussing on comparing the food webs on natural and artificial reefs by using stable isotopes to determine the dietary sources for organisms sampled from the Poole Bay artificial reef and a nearby natural habitat. A first round of samples has been analysed, revealing that the two reef systems are broadly similar. However, some differences have been observed, and these will be explored by further sampling this year.

Offshore oil and gas platforms act as large scale artificial reefs. Footage provided by BP and TOTAL is providing a means of comparing the growth of marine communities at several sites in the North Sea. Sampling of one or more of these sites could provide a more detailed picture of the species resident on these structures.

## Australia

### Joe Carolan

University of Wollongong

Natural product chemistry from the Australian deep sea

As part of his Honours project, Joe Carolan examined the secondary metabolite profile of a deep-sea urchin collected from the NW Shelf of Australia, which was found to produce a potent inhibitor of an enzyme that may play an important role in cancer and inflammation. The chemical structure of this inhibitor is currently being determined. Joe also had the opportunity to go offshore himself with Santos to the Songa Mercur at Fletcher in Carnarvon Bay, Western Australia, between August 17 and August 21, to collect deep-sea fauna (crustaceans, anemones) for further investigation.

### David Cummings

University of Sydney

Nutritional ecology of sea urchins

I will be investigating nutritional resources in deep-water organisms. The abundant deep-water urchin *Diadema sp.* has been chosen for investigation because of its important role in the deep water systems. My research is being carried out in Carnarvon Bay with Santos, it continues from the work of Gareth Andrews and will investigate the ecological processes that lead to selective nutrition in deep-water echinoderms.

### Ashley Fowler

University of Technology, Sydney

Connectivity between artificial reefs: the role of offshore installations

I will be working with Dr Dave Booth on this project to investigate the role of offshore installations in connecting deep-water reef fish populations. We have been developing light traps to capture reef fish that have settled around the offshore installations, we will use these samples to investigate the biodiversity of deep-water reef fish, the connectivity between populations and the role of the structures in fish aggregation.

# New Partnerships

## Shell Europe



We have started a new major partnership with Shell Europe. This collaboration will involve working at three sites, the Faroe-Shetland Channel, West Ireland and the Norwegian margin. We will be looking specifically at the ecological implications of the drilling activity as well as pushing the boundaries of our knowledge about the environment at each of these areas.

## Subsea 7



Our collaboration with Subsea 7 deepened in 2007 to become a formal partnership. We will now work together to integrate SERPENT protocols into Subsea 7's training packages, and hope to rollout SERPENT-based communications within the organization to raise awareness of the project. We hope this will not only increase buy-in to SERPENT by Subsea 7'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.

## StatoilHydro Venezuela



Our successful existing partnership with StatoilHydro expanded into a new business group – StatoilHydro Venezuela. With a successful visit under our belt and a strong collaboration with Universidad Simón Bolívar in Caracas we hope that we can take this project forward to gain more understanding of this very poorly explored area.

# 2007/2008 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 two sites in the deeper parts of the Channel where we know the least about the marine environment. We will be working with Shell and Chevron in this area with a potential additional visit sponsored by OMV, Austria's largest oil company..

## North Sea

Research at the Nexen-operated Buzzard field will continue over the course of 2008. 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.

## 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.

## 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 2008. This would build on our previous very successful visits and add to the innovative work of Dr Mark Benfield at the Louisiana State University.

## Ireland

We will be visiting two deep-water wells off Ireland in 2008: one, West Dooish, with Shell, and the other, Cashel, with StatoilHydro. These deep-water prospects are in a new environment for SERPENT but a more familiar ground for deep-sea science. We hope to use the potential of the ROVs for experimental biology to make some new insights into the biology of the Rockall Trough area that has not been possible with traditional methods.

## Norway

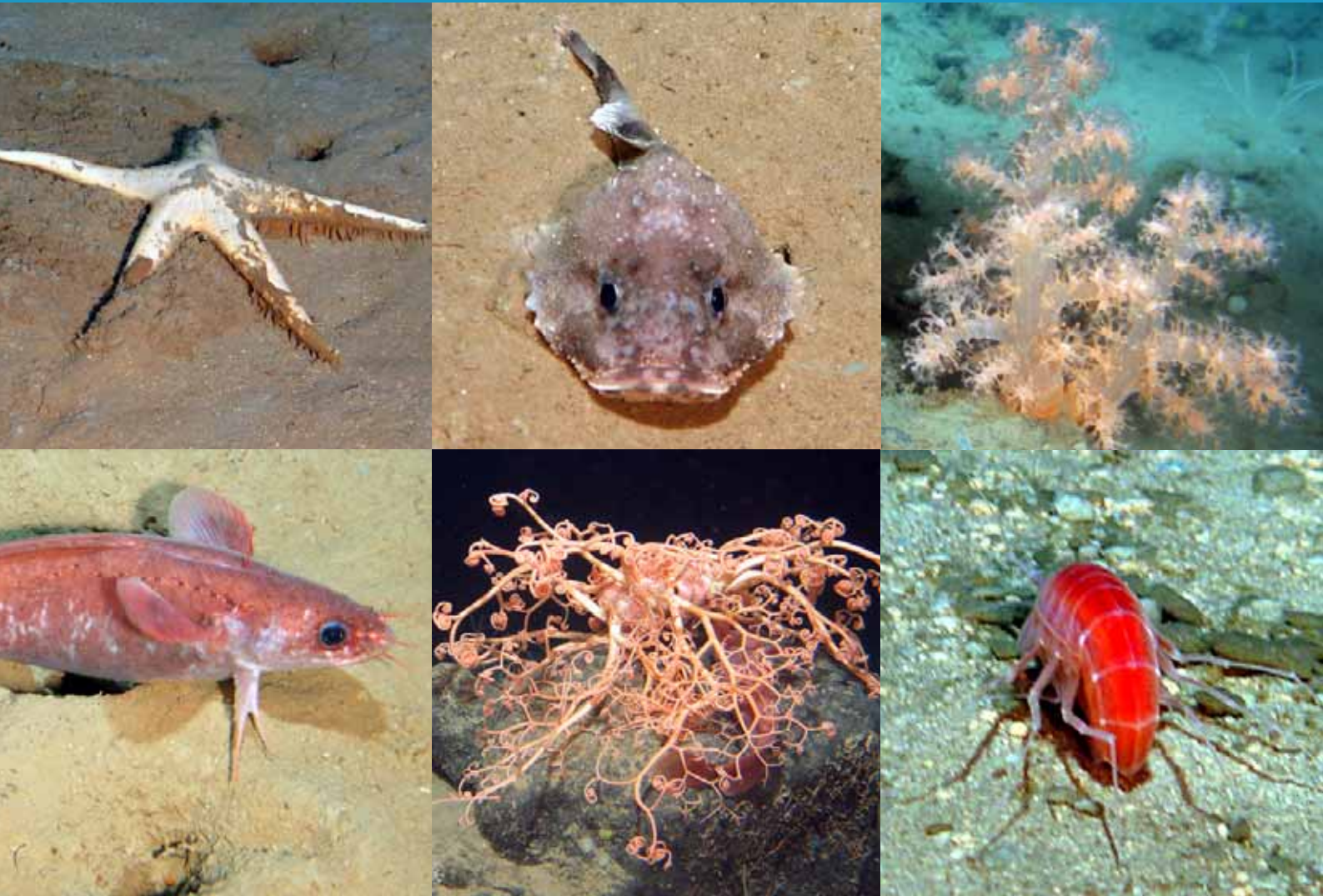
After a successful set of missions in 2007, SERPENT returns to work with StatoilHydro and Shell at two new locations: Gro and Haklang. We are planning to return to a well with StatoilHydro to see how the communities are recovering one year on from the drilling disturbance.

The enthusiasm from SERPENT, StatoilHydro and Oceaneering is really driving this collaboration forward. We hope that our new collaboration with Shell will be successful in Norway too.

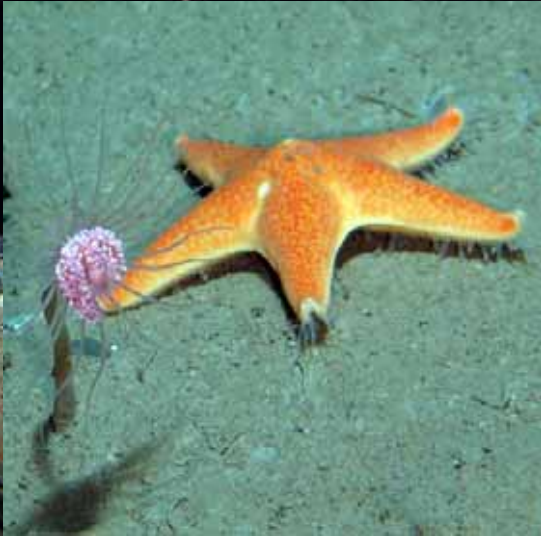
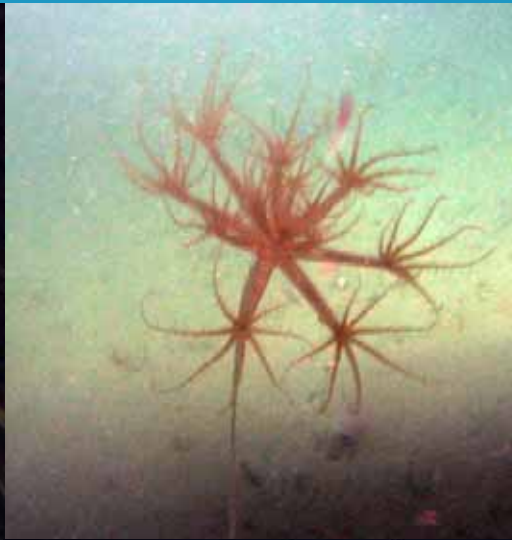
## Australia

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.

Top row, left-right: An asteroid (starfish) leaves its mark on the sea bed at Midnattsol, A sculpin (*Cottunculus* sp.), A soft coral attached to a rock on an otherwise muddy sea floor, A ray, possibly *Amblyraja hyperborea* and sabellid polychaete worms at 1000 m depth, A Ctenophore (comb jelly) drifting in the water column, A 2.5 metre tall *Umbellula* sp.



Bottom row, left-right: An Arctic Rockling (*Gaidropsarus argentatus*), A basket star (*Gorgoncephalus* sp.) on a rock on the sea bed, A scavenging amphipod viewed from behind, A Norwegian Redfish and common starfish, A hydroid (*Tubularia*) and an asteroid, Several *Gorgonocephalus* individuals with arms extended, filtering food from the current.



# Our Partners & Collaborators

## Industry

StatoilHydro  
TOTAL E&P UK and  
Total Foundation for  
Biodiversity and the Sea  
BP (UK)  
BP (Angola)  
BP (USA)  
Chevron Australia  
Chevron Canada Ltd.  
Chevron UK  
Kongsberg  
Nexen Inc.  
Oceaneering  
Santos Ltd.  
StatoilHydro  
Subsea 7  
Transocean  
Woodside Energy LTD

## Academic & Associated

Australian Museum  
BBC Natural History Unit  
Fisheries Research Services,  
Marine Laboratory, Aberdeen  
Louisiana State University  
National Marine Aquarium,  
Plymouth  
National Institute of Water &  
Atmospheric Research Ltd.  
(NIWA)  
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

Dr Penny Allen, BBC Natural  
History Unit  
Dr Mark Benfield, Louisiana State  
University  
Wendy Brown, Total  
Assheton Carter, Conservation  
International  
Dave Cawson, Subsea 7  
Bob Clark, Transocean  
Kristina Hardwick, GeoCet  
Ricky Holtom, Transocean  
Dr Ian Hudson, Transocean  
Emma Jones, National Institute of  
Water & Atmospheric Research  
Ltd. (NIWA)  
Ann-Marie McLaughlin, BP  
Arne Myhrvold, StatoilHydro  
Peter Oliver, Chevron  
Dr Adele Pile, University of  
Sydney  
Cara Price, Woodside  
Dr Ben Wigham, Newcastle  
University  
Karen Yorke, Nexen  
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