What lies beneath?

The oil and gas industry lets deep-sea biologists explore the deep, with captivating results, write Elisabeth Maclaren, Ian Hudson and Daniel Jones.

What's the difference between a remotely operated vehicle (ROV) pilot and a marine biologist? Well, the line is blurring. When *Planet Earth* first featured our project back in 2002, as a fledgling collaboration between BP and our co-ordinator, Ian Hudson, we had just completed a two-week pilot study in the drilling area west of Shetland. Exploring the deep-sea is expensive, but the idea behind the project is simple: as part of a normal working day, an ROV may be left idling on the seabed for hours, so it makes sense to use this spare time for scientific and environmental research.

Using two ROVs onboard the multi-purpose survey vessel *Regalia*, we carried out inventive experiments to document the behaviour and locations of species around an active oil field. We obtained footage of several new species, and of known species doing weird and wonderful things we never would have predicted. No one had ever seen an anglerfish *Lophius piscatorius* 'walking' using both the pectoral and pelvic fins. It seemed to do this to move short distances across the seabed, and apparently on occasion to get closer to its prey.

Three years down the line, this original project encompasses new areas of exploration, research opportunities and partners. The SERPENT (Scientific and Environmental ROV Partnership using Existing iNdustrial Technology) project now presses the oil and gas industry's submarine technology into the service of marine scientists. A host of industrial and scientific partners and collaborators have joined the founding partners: the National Oceanography Centre, Southampton (NOCS), BP, Subsea7 and Transocean. Now we can investigate deep-sea environments from offshore Mauritania, to the US, Australia and the North Sea.

Another bonus is that oil and gas industry ROV pilots send us vital materials collected during their routine operations. It is a superb win-win situation: we get to see interesting footage, and the pilots enjoy becoming part-time marine biologists. So far we have received over 1000 hours of footage from rigs and vessels around the world. Some includes evidence of new species, such as a large squid species loitering around the seafloor Well blow out Preventer (BOP) system at 3000m in the Gulf of Mexico. Our colleagues at the Smithsonian Museum said this was extremely important evidence of a new species, so now we and the ROV pilots are trying to capture a squid so that the species can be named.

Access to ROVs has also allowed a detailed study of micro-organisms living around cold methane seeps in the Gulf of

Opposite left: A Subsea7 Clansman 2 ROV operating off the Jack Bates drilling rig. This ROV is capable of diving to 3000m.

Opposite right: A brisingid sea star found on a pipeline at 500m offshore, west of Shetland.

Above: A Bolocera *sp. anemone living on a pipeline at 500m off the coast of Norway in the Barents Sea.*

Right: A Benthothuria *sp. deep-sea holothurian at 1200m off Mauritania, taken as part of a SERPENT mission from the Boa Deep C, working for Woodside Energy Ltd.*

Bottom right: A Chaunax *sp. frogfish photographed at 600m off the coast of Western Australia.*

Mexico that derive their energy from chemical reactions. Characterised by mussel beds, these seeps provide a fantastic habitat. Sea cucumbers within the beds feed on what appears to be bacteria, and heart urchins (spatangoids) plough through the mud. These echinoderms are filmed feeding on mud on the seafloor, using their oral tube-feet to gather detritus and leaving characteristic tracks wherever they go. Sea stars of varying shapes and colours both 'deposit feed', consuming sediment and digesting the organic matter, and also prey on other creatures within the methane seep. Living within the coral and sponge are small white crabs, most likely *Galathea* sp., with long slender claws suited for picking and collecting small prey and clumps of bacteria from within the mussels. The deep-water Gulf of Mexico is a hotbed of new species waiting to be discovered; further footage sent to us in May 2005 has yielded evidence of two new genera of large siphonophores, both more than 13 metres long.

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Access to ROVs has allowed us to develop new biological sampling methods. We use scavenger traps to collect deep-water amphipods, an abundant order of crustacea, normally difficult to capture using sediment coring and trawling. We have now identified the amphipods collected off the west coast of Shetland and found five species from three genera, including *Tmetonyx* sp., a potential new species. During a recent

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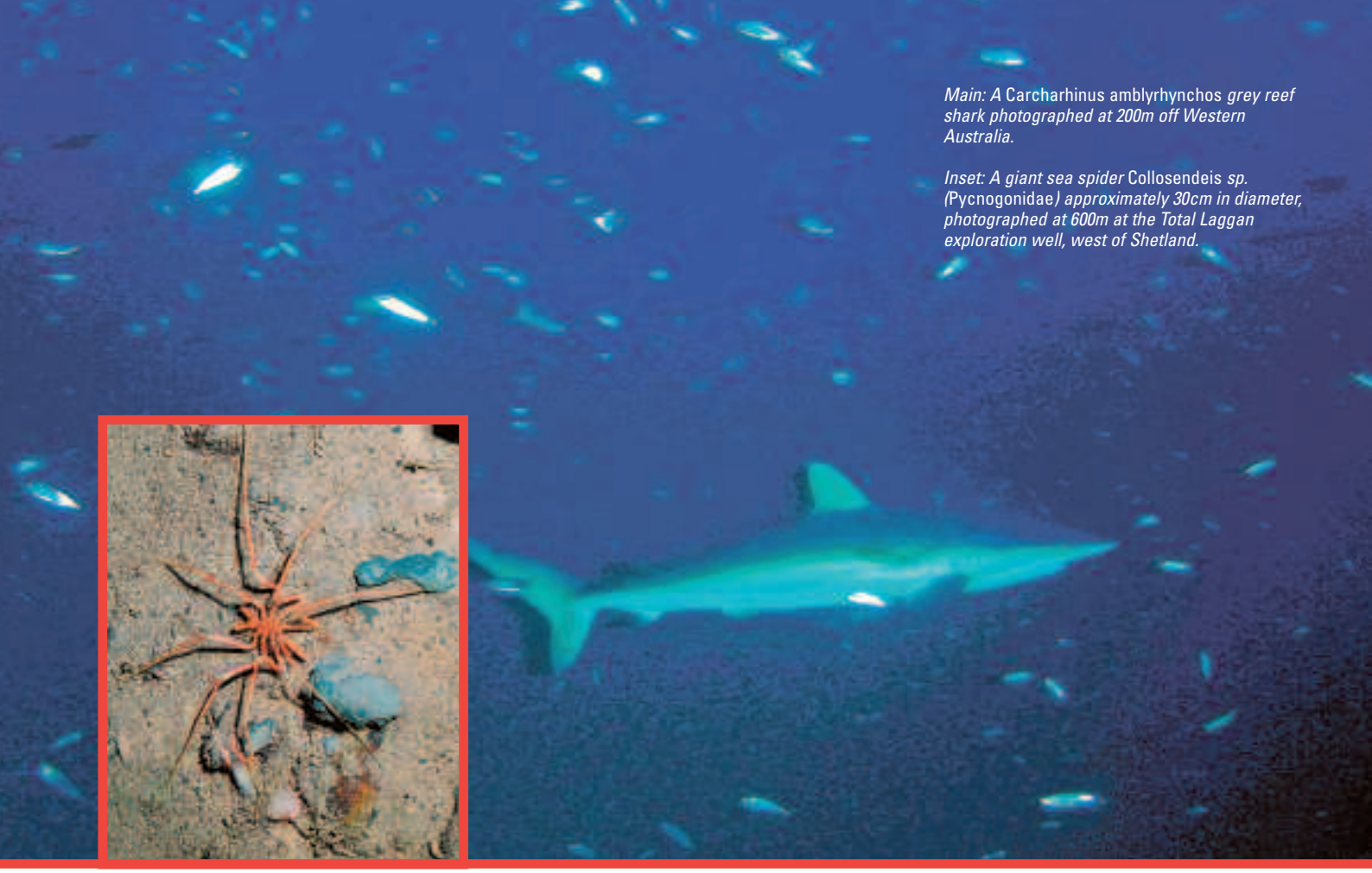

Main: A Carcharhinus amblyrhynchos *grey reef shark photographed at 200m off Western Australia.*

Inset: A giant sea spider Collosendeis *sp. (*Pycnogonidae*) approximately 30cm in diameter, photographed at 600m at the Total Laggan exploration well, west of Shetland.*

mission, ROVs used a suction hose to collect amphipods from the sediments in the Laggan oil field. The amphipods were from three different families: the Dexaminidae, the Pardaliscidae and the Epimeriidae. Samples taken on the same mission in 600m of water revealed specimens of *Epimeria loricata*, a colder water amphipod normally found in the Arctic and sub-Arctic.

One reason the oil and gas industry supports this project is because it is keen to understand the environments and the ecosystems around its offshore operations. Using ROVs is an extremely effective method of revealing how much of the seabed is affected by oil and gas exploration. A recent mission to the Otway Basin, south-east Australia, carried out detailed ROV video surveys of the area at 100m water depth around a drill and found the area to be dominated by hermit crabs. Our results suggest that spoil from the drill, mostly displaced rock and sediment, is not a significant problem for the crabs. Videos show them walking over spoil deposits and recolonising around the BOP system. The crabs actually bulldoze their way across the surface layer, an activity crucial for incorporating and dispersing spoil—potentially speeding up the recovery of seafloor wildlife communities. Footage like this shows we are in a unique position to look at how animals respond to drilling, pipeline laying and subsea development changing their habitat. Our programme also provides data for a project examining whether oil-rigs and seafloor structures act as artificial reefs from the surface to the seafloor.

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SERPENT is poised to forge more important links and partnerships. A new NERC knowledge transfer programme, the Deep-water Industry, Environment, Policy and Science (DIEPS) programme, will run alongside SERPENT to stimulate new approaches to deep-water ecological research aligned to environmental management issues and questions. The project will run innovative experiments in the deep-sea, and develop new ways to quantify the wildlife and characterise the seafloor from photographic and video ROV imaging. It will share new knowledge as digestible and practical advice to industry, environment and policy bodies. Through NERC's collaborative CASE award scheme, four new PhD projects will work within SERPENT.

Earlier in the year, we were featured in a BBC *World Earth Report* programme, and we are working with the BBC's Natural History Unit on a new documentary series to be screened in 2006. This year, we started to evolve our outreach and educational materials to share the progress the project has made with scientific communities and the public. We have more research missions and compelling footage under our belt than ever before, with scope for so much more—and we are relishing the opportunities and challenges ahead.

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