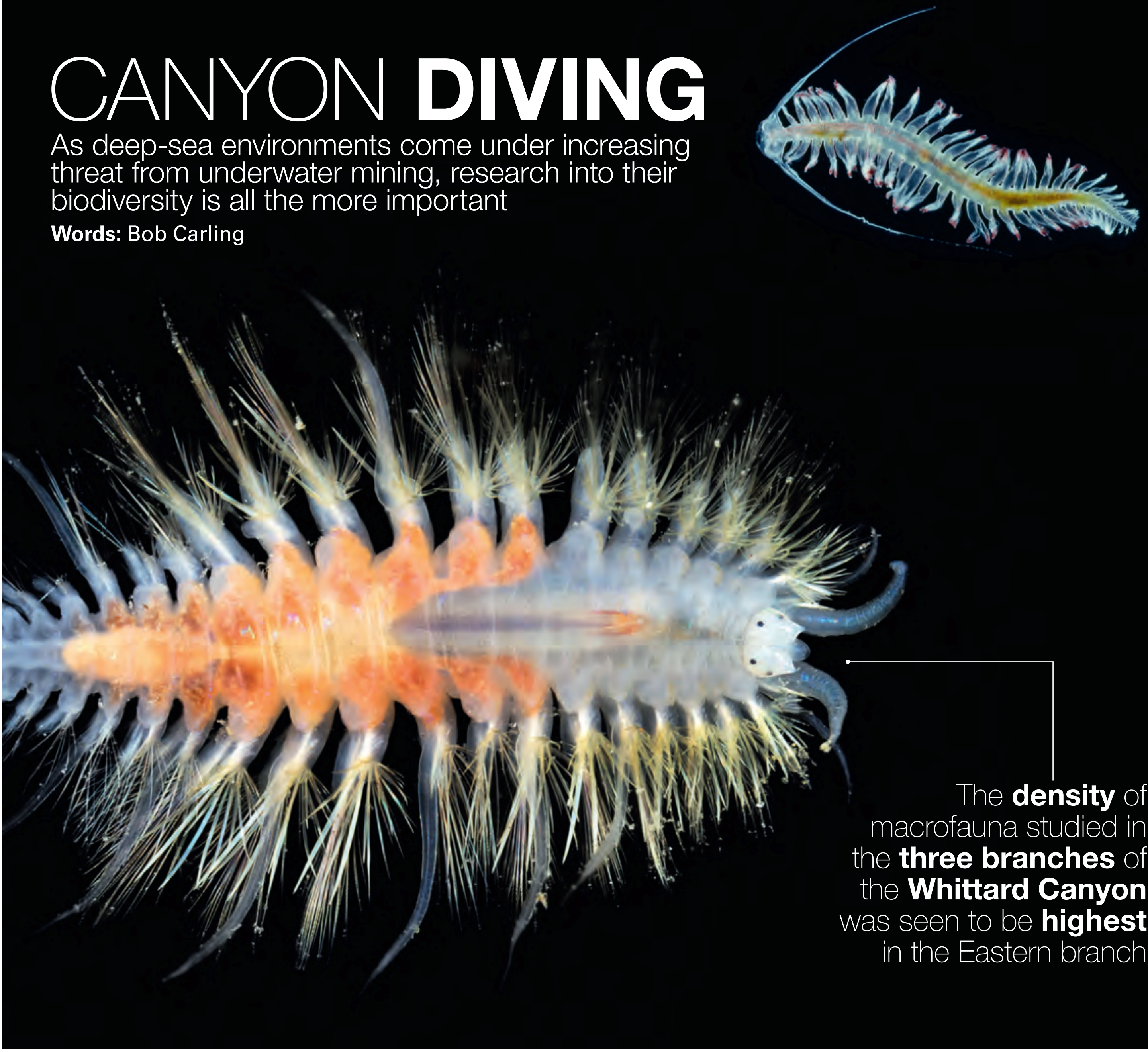
CANYON **DIVING**

As deep-sea environments come under increasing threat from underwater mining, research into their biodiversity is all the more important

Words: Bob Carling



The **density** of macrofauna studied in the **three branches** of the **Whittard Canyon** was seen to be **highest** in the Eastern branch

It is easy to imagine the Grand Canyon, with its rocky landscapes, stunning panoramic views and abundant wildlife. However, few people realise there are similarly spectacular features hidden kilometres beneath the ocean waves. Submarine canyons are steep-sided valleys that incise continental and island margins. They are numerous too: a recent estimate reported around 6000 large submarine canyons worldwide.

Submarine canyons are thought to be important fast-track conduits for sediment and organic matter from the continental shelf out on to the abyssal plain. The high volumes of organic matter funnelled through the canyon is thought to enhance marine life within it.

For this reason, submarine canyons are believed to be hotspots for deep-sea biodiversity, harbouring increased biomass compared with the adjacent open slope. Canyons are also dynamic environments subject to internal tides, turbidity currents (underwater landslides) and deep-water cascading events. Due to their disturbed conditions and rugged terrain, sampling inside canyons has been problematic. However, over the last two decades, high resolution mapping of the deep-sea floor – and improved precision of sampling equipment deployment – has opened up many new possibilities for canyon research.

Whittard Canyon

The Whittard Canyon is a dendritic canyon system located on the Irish margin in the northeast Atlantic. Three main branches are recognised inside the canyon system: Western, Central and Eastern branches. These coalesce together around 3700m to form a single canyon.

The canyon starts at around 400m water depth and descends to 4000m, where it opens

Ophiuroids, or 'brittle stars', are one of the few megafauna that dwell in Whityard Canyon

out onto the Porcupine Abyssal Plain. Steep-sided walls reaching heights of up to 800m are found in the upper part of the canyon. Although it is not clear how active the Whittard Canyon is, there is some evidence for turbidity currents and strong-bottom current activity at its base.

Work by researcher Laetitia Gunton, based at the Natural History Museum, London, and the National Oceanography Centre, Southampton, looks at the organisms that live inside the Whittard Canyon, focusing on the small sediment-dwelling organisms that live in and on the seafloor.

These 'macrofauna' consist of animals such as small-bodied peracarid crustaceans (tanaids, isopods, amphipods and cumaceans), polychaete and oligochaete worms, as well as ophiuroids (or 'brittle stars') and the marine molluscs aplacophora. The macrofauna are abundant in most deep-sea soft sediments and thus are a useful indicator for estimating levels of faunal abundance, diversity and composition.

These small organisms are sampled with a 'megacorer', a hydraulically damped multiple-corer. This is attached to a long cable and lowered off the side of the ship to the seabed, where it collects a core section of the seafloor sediment. As reported recently in *Deep-Sea Research I*, megacorer samples were taken from the three main branches of the Whittard Canyon and one site on the adjacent slope to the west of the canyon – all at a depth of 3500m.

Density of life

The researchers found a higher density of macrofauna inside the canyon compared to the adjacent slope. The density of macrofauna increased across the study site from west to east with the highest density in the Eastern branch of the canyon.

There were also significant differences in faunal composition between the three branches of the Whittard Canyon (Western, Central and Eastern) and between the canyon and the open slope. These differences in density and faunal composition were linked to varying inputs of organic matter throughout the canyon together with differing hydrodynamic activity in the different branches of the canyon.

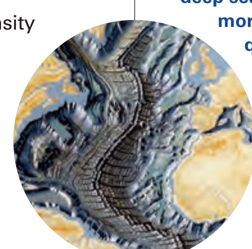
As Laetitia Gunton, lead author of the research paper, says: "This research is interesting because it shows that not only do canyons contain a faunal composition different from that of the continental slope but also that the faunal composition varies within a canyon itself. It is important not to think of canyons as a single habitat but a patchwork of many habitats with different biological and physical conditions throughout."

Disturbed residents

Canyons are dynamic and often turbulent environments, quite different from the rest of the deep sea, which is mostly quiescent. Thus they are ideal locations to study the effects of disturbance on the resident fauna.

This is important because bottom trawling for commercial fishing is descending deeper into the oceans and deep-sea mining is also on the horizon. As this happens, areas that until now undisturbed by human activity will experience it for the first time. Understanding how the benthic fauna will respond will put us in a better position to limit the consequences of human incursion.

Quicker, cheaper seabed mapping



Researchers at the National Oceanography Centre (NOC) in Southampton, UK have developed a new, automated method for classifying hundreds of kilometres of the deep sea floor, in a way that is more cost efficient, quicker and more objective than previously possible.

Currently there is very little information about the geographic distribution of life on the seafloor. This is largely because of the practical difficulty in accessing creatures which live at such a great depth in the ocean. However, this research soon to be published in the journal *Marine Geology*, reveals a new method of estimating this distribution using a combination of submarine mapping technology, statistics and a 'landscape' ecology technique called 'Niche Theory', which is generally used on land.

The Niche Theory states that biodiversity is driven by spatial variability in environmental conditions, i.e. the greater the range of habitats, the greater the biodiversity. Lead author Khaira Ismail from the University of Southampton used this concept to create broad-scale, full coverage maps of the sea floor. The objective of these maps is to estimate the location of biodiversity hotspots, by identifying areas where the deep-sea landscapes are relatively more varied.

Dr Veerle Huvenne from the NOC said, "by informing us of where to look and where to plan more detailed surveys, this new method will help to make our deep-sea research more targeted and efficient, by advancing our understanding of life in the deep ocean. At the moment this still very limited."

These maps cover areas approximately 200km across, and have pixel sizes around 25m. They are created using information on the topography and sediment type of the sea floor, collected from a multi-beam echo sounder and a side scan sonar, respectively.

The resulting map is then analysed in order to break down the sea floor into a series of zones, using statistical analysis to identify distinct 'geomorphological terrains' in an objective and repeatable way.

Khaira said, "using statistical methods to identify these 'terrain zones' allows us to be more objective than if we were picking them out by hand. This objectivity means that the results are consistent and repeatable, which allows different areas of the sea floor to be compared more easily."

This research forms part of the €1.4 million European Research Council funded CODEMAP project, and was applied in the Lisbon-Setúbal and Cascais Canyons, off the Portuguese coast. These submarine canyons were classified into six marine 'seascapes', based on their geomorphological features.

Future work will use a submarine robot to take photos and videos of life in the deep-sea areas, allowing researchers to start identifying new deep sea habitats.