OCEAN NETWORKS CANADA

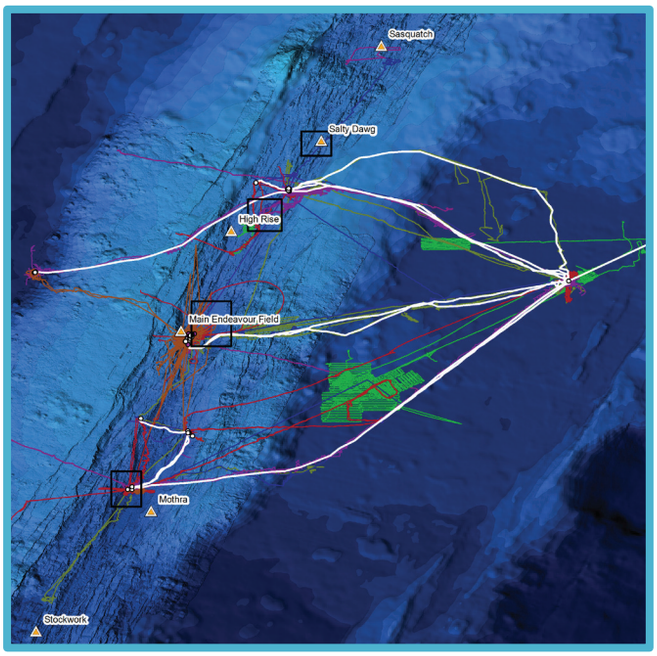
Right: Remotely operated vehicle (ROV) ROPOS *prepares to descend for another dive.*

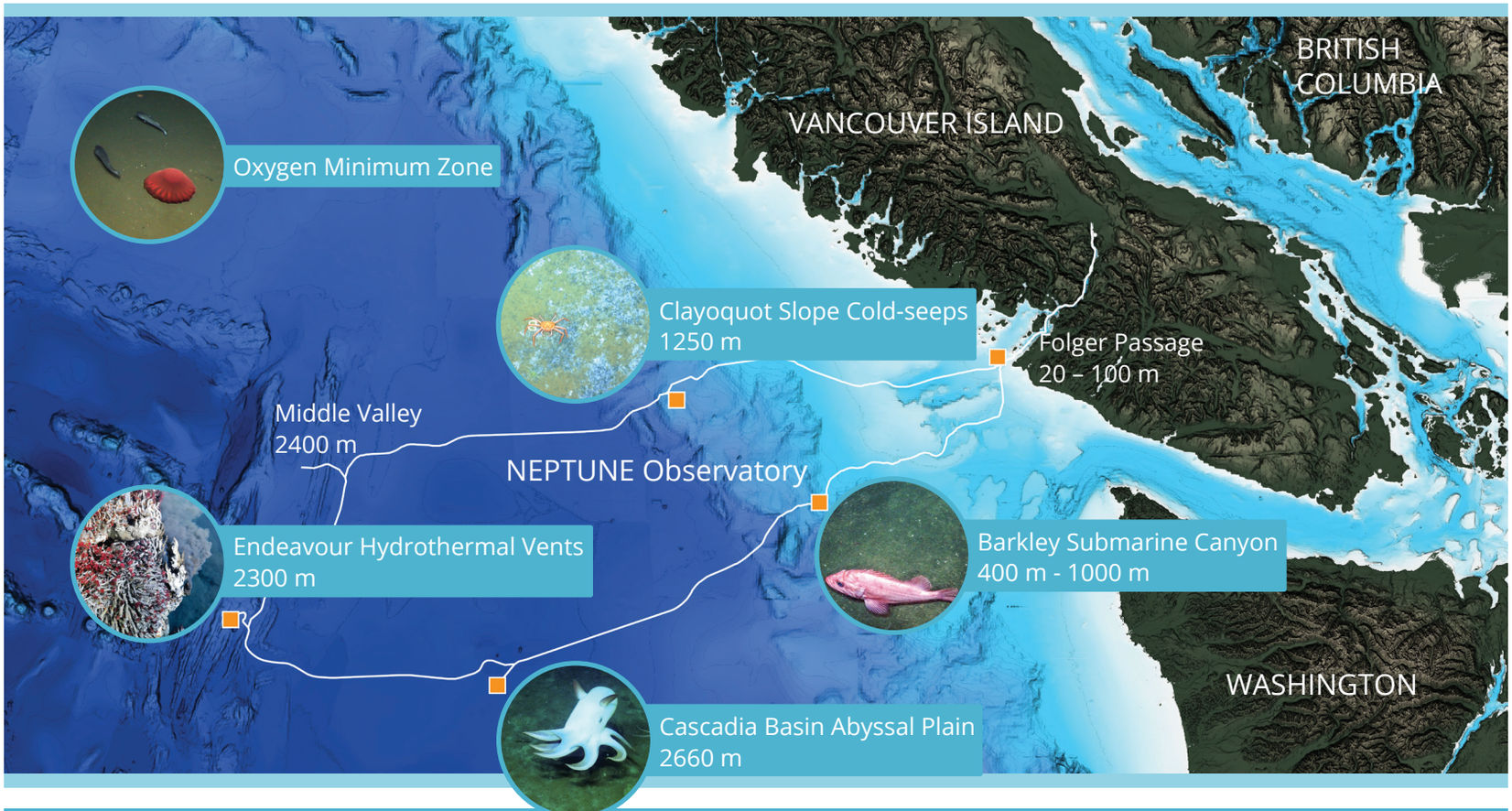
INVESTIGATING DEEP-SEA BIODIVERSITY FROM ROV VIDEO IMAGERY

ONC has gathered video imagery of North East Pacific deep-sea environments from more than 350 ROV dives spanning the last 12 years. Thousands of hours of video footage, which include seafloor transects for studying benthic megafauna and mid-water vertical surveys for studying pelagic organisms and gelatinous plankton, are all open access and freely available through ONC's SeaTube video database system, accessible at **data.oceannetworks.ca/SeaTube**

ONC has generated more than 200 peer-reviewed publications. Each year 15-20% of the scientific output from ONC currently comes from video data of a variety of seafloor habitats.

Below: Endeavour Marine Protected Area. ROV tracks from ONC's yearly maintenance cruises overlay the cabled observatory infrastructure.

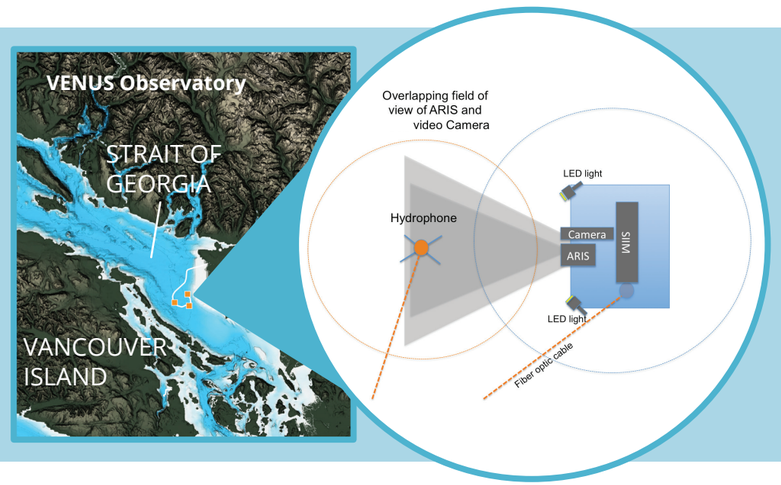


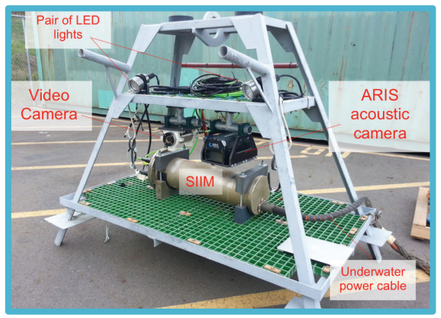


COASTAL OBSERVATORIES

Understanding whether fish communicate using sound is of growing interest and importance. Although many fish species are soniferous—they naturally produce sounds—we know very little about how and why this happens. Among the approximately 400 known marine fish species swimming in British Columbia waters, only 22 have been reported to be soniferous, although many more species are suspected to produce sound.

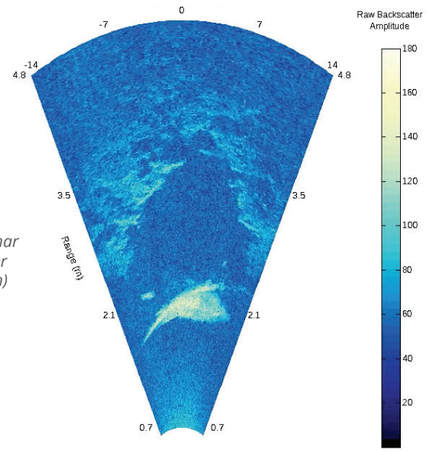
Below: Schematic of the seabed configuration of the "Fish Acoustic Experiement" at VENUS Delta node.





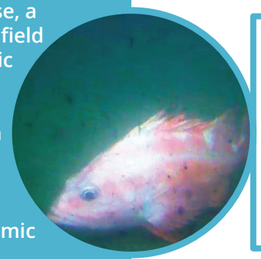
Left: Instrument platform connected to the VENUS observatory.

Right: ARIS dual frequency sonar image showing the backscatter signal of a skate (a type of fish) passing by.

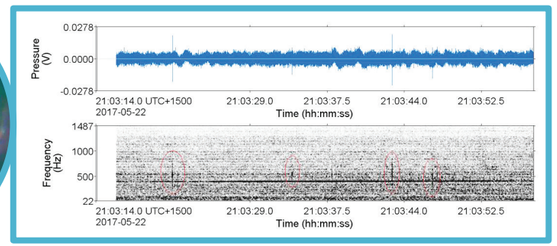


Combining video and passive acoustics (e.g., hydrophones) with acoustic imaging, the "Fish Acoustic Experiment" aims to better understand fish behaviours through fish-emitting sounds, and to explore how human-made sounds—such as shipping noise—affects those behaviours.

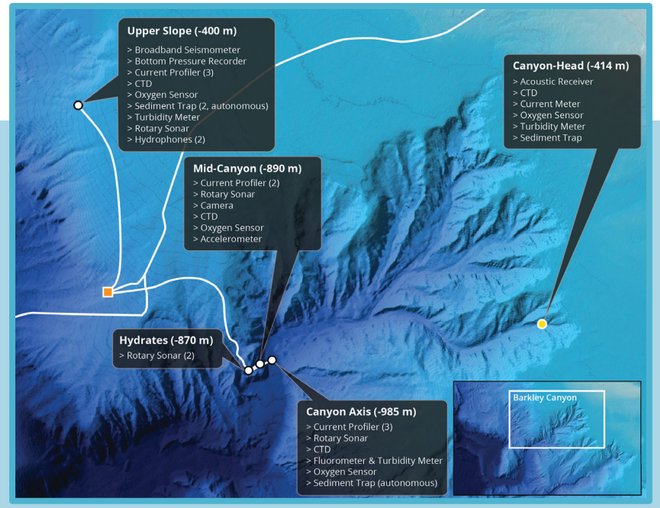
To listen to fish and background noise, a hydrophone is positioned within the field of view of both the video and acoustic cameras so that sounds generated by fish will be easily associated with camera images. The acoustic camera is particularly useful at this location in the Strait of Georgia where waters often get "murky" due to the suspended sediments from the dynamic Fraser River delta.



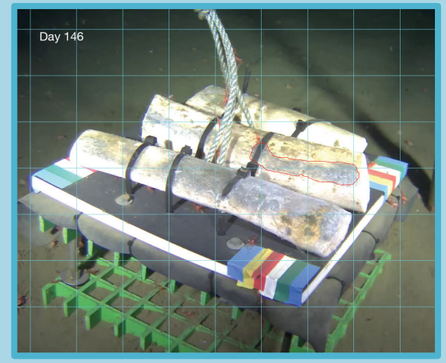
Rockfish: *Sebastes* spp.



Above: Sound and pressure signals are identified when fish are observed near the camera.



BARKLEY CANYON



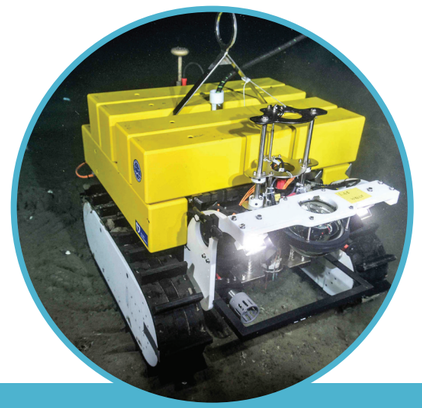
Above: In the deep sea, whale-bone and wood falls occur widely and may contribute fundamentally to biodiversity and evolutionary novelty; nonetheless, large-scale patterns of biodiversity, connectivity, and ecosystem function in these organic-rich metacommunities remain essentially unexplored. In this pioneer experiment using ONC's cabled observatory in Barkley Canyon, whalebone and wood substrates are being used to evaluate bathymetric, regional, and inter-basin variations in biodiversity and connectivity, as well as interactions between biodiversity and ecosystem function at the deep-sea floor.

Barkley Canyon is a highly sinuous, shelf-incising submarine canyon located ~100 km offshore Vancouver Island in the North East Pacific. Barkley Canyon harbors a mosaic of benthic habitats and biological communities, combining methane seeps with hydrate outcrops and patches of deep-water corals with flat sedimented seafloor, all bathed in hypoxic waters within the upper and lower boundaries of the North East Pacific oxygen minimum zone (OMZ).

Much of our knowledge of tanner crab (*Chionoecetes tanneri*) biology comes from analyses of crabs caught in trap and trawl surveys at different depths and at different times of year. Direct observations of these crabs and other deep-water species are rare.

Long-term video monitoring from cabled observatories provides ocean scientists with a powerful new tool to study the movements of species as they migrate to and from deep ocean depths. Such information is important for biodiversity conservation and the sustainable management of deep-sea fisheries.

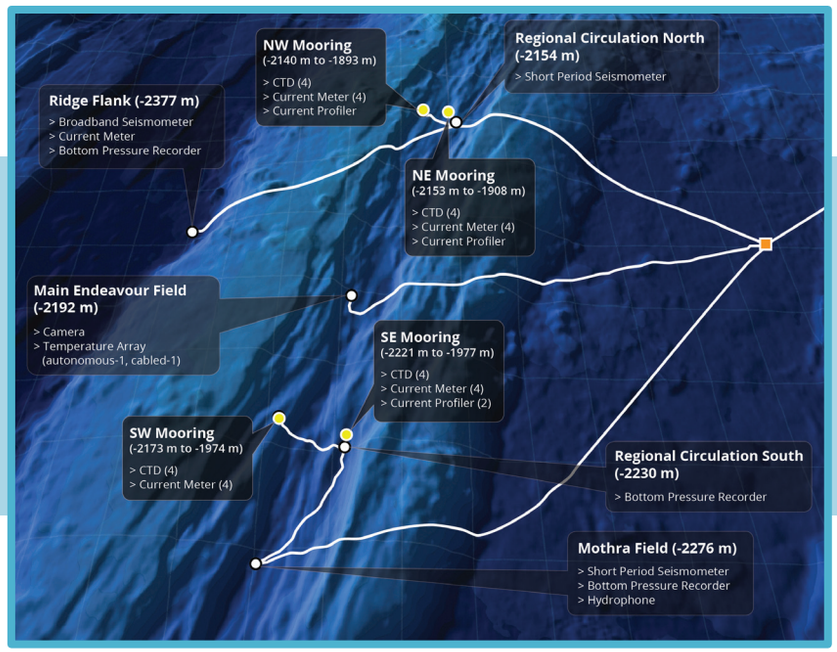
Top right: Mass Tanner crab migration caught on Barkley Canyon's deep-sea camera at the Axis observatory site 970m, in January 2015. Bottom right: Same location, four hours later.

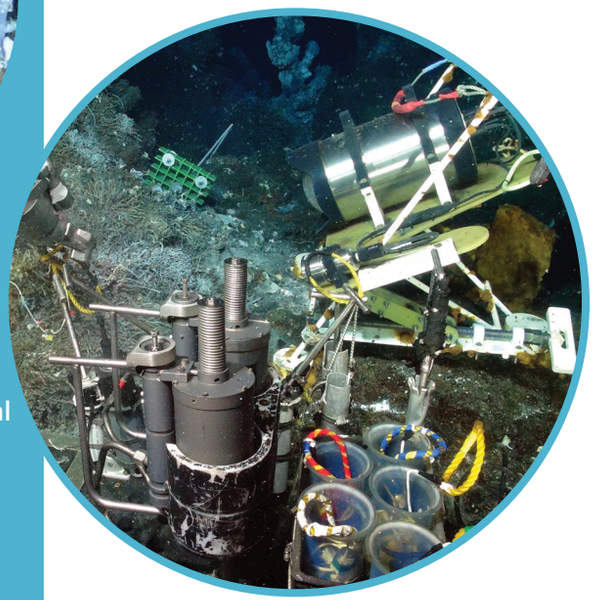


The Internet-operated vehicle Wally (left) monitors a 15,000 m2 area of a cold-seep habitat in Barkley Canyon. The site also harbours extensive and patchy methane hydrate outcrops. Scientists are interested in the temporal dynamics of methane hydrates as well as in the benthic diversity (including microbes) and its relation to ecosystem function in the area.

ENDEAVOUR

Endeavour (depth 2200-2400 m) is a northern segment of the Juan de Fuca Ridge which, in turn, is part of the complex, 80,000 km long mid-ocean ridge system spanning the world's ocean. Juan de Fuca Ridge is a medium rate spreading centre (~6 cm/yr) forming the divergent boundary between the Pacific (to the west) and the Juan de Fuca (to the east) tectonic plates.

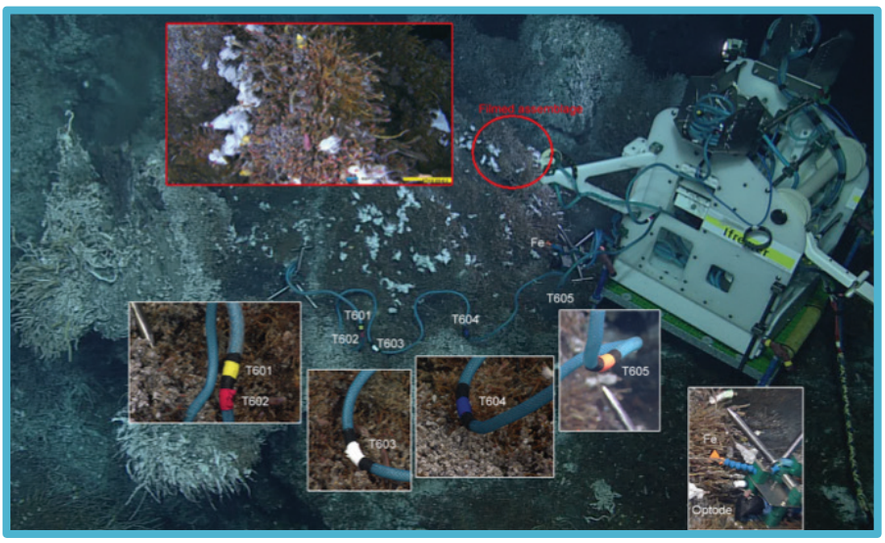




Hydrothermal vents host some very unique ecological communities. While most of the deep sea depends on near-surface productivity with photosynthesis as its fundamental energy source, vent communities are completely independent from the surface and sunlight. Bacteria are able to use reduced compounds from the vent effluent as an energy source (chemosynthesis). These bacteria can be free-living or symbiotic and are the base of the food web of these communities where 90% of the species are endemic to this special environment. The tubeworm Ridgeia piscesae grows in large colonies in diffuse venting areas, supported by the symbiotic chemosynthetic bacteria developing in their cells. These worms have no mouth and rely on their internal symbiotic, bacteria to survive. Other species living within hydrothermal communities include limpets, worms (scale and sulphide), fish, and sea spiders.

Left: A digital stills NIKON-D70 camera was installed at ONCs' Main Endeavour Field site in 2014. Several autonomous temperature loggers are deployed in the camera's field of view. 24-Mpx photographs are captured in a time-lapse mode at four-hour intervals. Scientists from ONC, Ifremer, and Washington State University are interested in how hydrothermal diffusive flows affect the spatial and temporal distribution of vent fauna.

Below: Tempo-Mini is a custom-designed instrument package for real-time monitoring of hydrothermal vent communities and their environment. Tempo-Mini is equipped with 4 x 20 W LED lights and a Sony Axis Q1755 video camera recording videos with a resolution of 1440 x 1080 pixels and a frame rate of 24 fps. A localized micro-chloration system protects sensor optical parts and projectors from biofouling.



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