2023 | HEALTH DIAGNOSIS OF DEEP SEA CORAL

FKt230417 | #DiagnosingDeepCoral

- Puerto Rico, USA
- 17 April - 6 May 2023
- Dr. Colleen Hansel, Woods Hole Oceanographic Institution
- Ship Track

WOODS HOLE OCEANOGRAPHIC INSTITUTION

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- **20** science days
- **51** terabytes of data collected
- **26** ROV dives
- **2,730** sq km mapped
- **36** CTD & rosette casts
- **671** ROV samples collected

Expedition objectives:

- Explore the waters surrounding Puerto Rico and assess the overall productivity, biodiversity, and health of deep-sea corals.
- Test two newly designed instruments for measuring reactive oxygen species called ROS *in situ* — a device called DISCO, which stands for Diver-operated Submersible Chemiluminescent Sensor, for shallow depths and lab measurements, and an instrument mounted on ROV *SuBastian* for deeper depths called SOLARIS, which stands for Submersible Oceanic Luminescent Analyzer of Reactive Intermediate Species.
- Evaluate ROS concentration and production in coral gardens that live along biogeochemical gradients and link them to ecological, physiological, and evolutionary processes.

Corals play a foundational role in deep-sea ecosystems by providing habitats where invertebrate and fish communities can thrive. Corals produce extracellular reactive oxygen species called ROS, which are short-lived oxygen-containing molecules. These molecules play an essential role in all living creatures' health and ecological interactions, as they are needed for breaking down food, fighting off diseases, and healing wounds.

Previous research by the Hansel Lab demonstrated that shallow corals produce the ROS hydrogen peroxide. In April of 2023, Chief Scientist Dr. Colleen Hansel led a team of scientists and engineers to investigate whether the detection of elevated hydrogen peroxide signals can be used as an indicator of coral stress. While scientists have been able to study corals in shallow waters, there is a lack of ROS data for deep-sea corals because of their inaccessibility in the deep Ocean. The science team is working to understand the mechanisms, role, and impacts of ROS production in deep-sea corals, and this expedition brought researchers closer to bridging the data gap.
ROS must be studied in situ. Collecting samples for lab analysis will not work because the molecules are unstable and react almost instantly with other molecules, vanishing in about 30 seconds. To determine if and how deep-sea corals produce ROS, a novel sensor called SOLARIS was integrated into ROV SuBastian. SOLARIS was designed to measure ROS in the water and at depth — deep-sea corals' natural environment.

The new sensor was used to conduct the first systematic and targeted investigation of ROS production associated with deep-sea corals. SOLARIS provided essential data on coral stress, which led scientists to gain new insights into how ROS influences coral ecology, physiology, and health. The sensor design was based on a handheld version, DISCO. Hansel and a Woods Hole Oceanographic Institution team developed both devices, and Schmidt Marine Technology Partners funded DISCO.

The science team explored several locations in the waters off Puerto Rico with ROV SuBastian, including Whiting Bank, Desecheo Ridge, and Esperanza Ridge. They successfully measured high ROS levels for an Aplysina sponge and documented the first observation of extracellular ROS production by a black coral. This information could help scientists better understand how these deep-sea corals are reacting to human activity and changing ocean conditions.

The researchers found that this area of Puerto Rico — with fewer nutrients in the water column — has corals managing to survive and proliferate. To Hansel, this has the potential to open up a whole new area of science because the corals in Puerto Rico are completely different from what they've seen elsewhere. The ability of corals to thrive despite the lack of nutrients raises exciting new questions about how corals may allocate energy resources in relation to their surroundings. Following analyses, scientists expect to learn about the biogeochemistry of deep-sea corals living in Puerto Rican waters, which will inform the management of these ecosystems for years.

Resulting highlights include:

- Encountering a lush forest of deep-sea corals and associated animals living along Desecheo Ridge; the team also observed several corals and sponges not previously documented in the region, expanding the knowledge of what exists there.
- Detected a burst of ROS hydrogen peroxide in a wounded deep-sea Paramuricead, a genus of Gorgonian-type octocorals, which could be a mechanism for repairing wounds; this also provided a diagnostic indicator of stress.
- First documented observation of extracellular ROS production by a black coral.
- Two new ROV-based instruments, SOLARIS and DISCO, were successfully used; these chemiluminescent detectors for measuring reactive oxygen species in situ help scientists bridge a data gap about deep-sea corals and their responses to stress.

Permit to conduct research in Puerto Rican waters: 2023-IC-019 (O-VS-PVS15-SJ-01351-01022023)