Classnotes

What kind of diversity is found at deep reef depths?

Carole Baldwin ('81) discovers new fish species BY COLLEEN DIXON ('18P)

"It just goes to show how little we know about diversity at depths just below those accessible using scuba gear," says **Carole Baldwin ('81),** a marine biologist with the Smithsonian Institution. Baldwin is discussing progress in the Deep Reef Observation Project in the Caribbean. She is the lead investigator in the Deep Reef Observation Project, DROP, documenting local biodiversity to a depth of 300 meters in a .02 km^2-area using a manned submersible. (In comparison, JMU campus is almost 3.0 km^2)

"It will be years before we get a feel for how diversity and environmental conditions are changing at deep-reef depths," in the southern Caribbean and throughout the world's oceans, according to Baldwin.

The Deep Reef Observation Project began in 2011 in the waters off Curacao, using the submersible Curasub. The reef drops quickly to abyssal depths not far from the Curacao Sea Aquarium, alleviating the need for a mothership. Once the sub is craned into the water, it can be at its maximum depth in approximately five minutes – not a bad commute to work.

(Above) Carole Baldwin ('81) with Curacao Sea Aquarium and Substation Curacao owner Adriaan "Dutch" Schrier descend in the Curasub submersible off the coast of Curacao to explore the deep reefs that extend from 150 to more than 1,000 feet below the ocean surface.

Of thousands of potential research questions, the list of necessity was whittled to a handful:

- *How does species diversity change from shallow reefs – those with a depth less than 30 meters – through deep reefs, those greater than 150 meters?*
- *What percentage of this diversity represents new species?*
- *What species have broad vs. narrow depth ranges and how do upper and lower depth limits of species correlate with ocean temperatures and thermoclines?*
- *What role might deep reefs play in the survival of shallow reefs?*

Shallow reefs are in trouble around the world. "Comparatively little is known about tropical mesophotic and other deep reefs, including the diversity of life they harbor, how they change over space and time, and what role they may play in the survival of shallow reefs above," says Baldwin."

More than 20 scientists from Smithsonian museums and research labs are assisting with DROP, a chemist, marine biologists, ecologists and molecular geneticists. All see deep-reef work as an extraordinary opportunity, although specific reasons differ among the varying scientific fields. For Baldwin and other diversity experts, "there has been no comparable effort anywhere to characterize deep-reef diversity through repeated submersible exploration of one small area," she says. "Our samples are enriching the Smithsonian's archival collections of organisms and greatly enhancing our library of DNA sequences. Both of these are extremely useful for evolutionary studies."

For marine ecologists, coral-reef ecosystem monitoring has been conducted on shallow reefs for decades, but transferring the monitoring systems to deep water is tricky. Trickiness aside, the interconnectedness of deep and shallow reefs argues for monitoring at depths beyond the shallow zone typically studied. DROP broke new ground in 2012 by using the hydraulic arms of the submersible to deploy monitoring gear at depths of 250 meters, including temperature loggers and autonomous reef monitoring structures.

Species new to the project are collected on every sub dive. To date, approximately 90 fish species have been collected, and 25 percent of them are new to science – an astounding figure, considering the small size of the area. "This represents a rate of discovery unprecedented in modern marine ichthyology," says Baldwin.

In 2012 DROP deployed Autonomous Reef Monitoring Systems at depths up to 224 meters using the Curasub's hydraulic arms. Additional ARMS were placed on the shallow reef for comparative purposes. All deployed gear will remain in place for one year after which they will be retrieved, processed and redeployed. Successful acquisition of one year of data on temperatures and invertebrate/algal diversity on a reef slope from 15 to 250 meters will be a scientifically unique accomplishment. "There is no comparable data set from anywhere else in the world," says Baldwin.

For students interested in this research, Baldwin says that, while sub diving is popular with the scientists, there is much to be done at the Smithsonian. Organizing, labeling and possibly editing the growing amount of high-definition submersible video footage is crucial. Taxonomic work includes identifying organisms and describing new species. Baldwin also hopes to include "donor-funded" research, where she envisions donors being able to participate in diving, to see students at work.

→ DIVE INTO more about DROP and get a sub-level view by watching the video at ocean.si.edu/ocean-videos/deep-reef-observation-project-drop-video.

SUBMERSIBLE PHOTOGRAPH BY BARRY BROWN AT SUBSTATION CURACAO; BALDWIN BY MATTHEW WORDEN