REEF NEWS

findings and happenings of note in the marine world

Send in the Drones: New Tools for Coral Reef Research

When Australian scientists wanted to monitor conditions on the remote John Brewer Reef, located 45 miles off Townsville, they faced two realities of oceanic research: It is expensive and it can also present dangers to human divers in the form of violent weather, large sharks and saltwater crocodiles. They turned to what may become the tools that allow an unprecedented boom in our knowledge of what is taking place on coral reefs of the world: drones—including remote-piloted robots in the air and under the surface of the sea.

The Australian Institute of Marine Sciences (AIMS) team took their Blue ROV2 (Remotely Operated Vehicle) and launched it off their research vessel Cape Ferguson to explore conditions of Brewer, which is part of the Great Barrier Reef. They found that a new class of robots helped them collect data on larger areas and new sections of the reef, including locations that would have been hazardous for humans. With increased drone usage, scientists are freed up to analyze and process the data and images collected by drones and work towards solutions for protecting the reef.

Drones, of course, are unmanned and can be fitted with many different sensing instruments, cameras, and other gadgets. They can go above and below the water, and they cannot suffer medical injuries while working hours from the nearest hospital. The Blue ROV2 uses semi-autonomous navigation and takes the place of a dive team, who would normally transect and collect data to monitor its health. The robot has a hyperspectral camera that can sense color intricacies far richer than the human eye can perceive, and it has the capability to map the ocean floor, measure ocean depth, and identify bleached corals.

On the other side of the ocean, in Palo Alto, California, at the Schmidt Oceanographic Institute, more drone research is going on. One of the biggest proponents and developers of this new autonomous tool is Trent Lukaczyk, PhD, the co-founder and CTO of FlightWave Aerospace Systems, Inc., a company that manufactures autonomous robotic crafts that collect surface-of-the-ocean data. Dr. Lukaczyk and a crew of scientists recently went out on the Schmidt Ocean Institute's R/V Falkor, traveling 1,000 miles to the study area, where they spent days launching FlightWave drones and other drones that collected underwater data.

The aerial drone used is called the Edge, and it's particularly good at taking samples and readings from the ocean. And, because

AIMS Technology Transformation leader Melanie Olsen with the Blue ROV2, an underwater drone.

AUSTRALIA INSTITUTE OF MARINE SCIENCES

San Diego-based Falkor Mission scientists with flotilla of submersible and aerial drones.

COURTESY TRENT LUKACZYK, PH.D.

they were surrounded by water, the drone had only one place to land: a 3-meter square landing space on the boat. Dr. Lukaczyk says that the drone "had to be able to take off and land like a quadcopter but be able to fly like an airplane." It was successful, even in winds up to 22 knots; the Edge is resistant to gusts and hovers well in windy conditions. In addition to the three Edge drones, the team also brought along six unmanned underwater vehicles to take readings below the surface. Dr. Lukaczyk reports, "Operating robots over the water is a difficult challenge, so that's one of the things we're super excited about: that all of the robots we got out, came back with us." The Edge has vertical take-off and landing capabilities and swappable nose cones that contain different types of sensors and cameras. Onboard, the crew found that they needed two sensors they did not possess, so they printed them on a 3-D printer: one was a thermal sensor, and the other a gas-detecting sensor.

So what data did they collect, and how exactly did they do it? Lukaczyk says, "We flew over the front with basically every asset we had—we had underwater vehicles swimming about 20 miles or so on the water, we had the Falkor cruising the same direction, and we were flying the Edge and reporting to the Falkor and the rest of the robots, and while we were moving, everyone was picking up data at the same time. The Edge was flying the DMS sensor, which is able to detect special gas that is emitted from phytoplankton, and we got some really interesting data that we are going to try and correlate with the sensors that were under the water and on the ship at the same time." Over the course of the three-week trip, the crew of the Falkor collected over two terabytes of data, including many data points on temperature and salinity. They found that salinity change corresponds with temperature change. They say were able to use the robots to solve data collection problems fluidly and quickly.

Lukaczyk sums up the promise drones hold:"The future application for drones is being able to collect a lot of data really quickly with very high resolution. I like to think of UAVs or drones in general as having the ability to push the performance frontier in resolution of time, space, and wavelengths of light. Not only can they cover a large area, but when we are talking about wavelengths, coral reefs have awesome things to see if you're looking in a multispectral or hyperspectral camera. If you are taking high-resolution pictures of wavelength, you are looking at individual buckets of types of light coming in, and you are able to look at that picture and correlate that to a species of coral. If you do that one or two times per day over a month, you can start tracking growth and decay for coral. That's very valuable information, because as the ocean is heating up and becoming more acidic, coral reefs are reacting and changing more quickly than scientists were expecting. So that's one awesome competition for drones: to be able to monitor the health of coral reefs and as we put together plans to help change them and react to the ocean climates to be able to monitor our progress and to actually save them."

Drones also allow scientists to see parts of the reef that would be impossible for a human to access. As Lukaczyk puts it, "In general, having a robotic asset—if you're looking to get enough data, resolution, and visibility—it's a lot better for the human to hang back and to tell the drone where to go but stay removed."

There are even more applications for this new technology. Drones will drastically speed up the process of mapping islands, help with weather modeling, and monitor thermal vents and potential earthquakes. They can monitor marine-protected areas to help avoid overfishing and fish population collapse. Says Lukaczyk: "We've experimented with an organization called Protected Seas that's meant for tracking vessels in marine protected areas and working in with law enforcement to make sure people are not illegally fishing. Drones can also be collecting data in the water to see if the fish are actually reproducing or not. Enforcing marine-protected areas is going to be a really exciting thing we see in the future." Dr. Lukaczyk likened the trip to "taking an EKG" of the ocean. "It's fundamental to the operation of that part of the ecosystem—and everything else on Earth that depends on the ocean."

—Bayley Freeman

REFERENCE

Seafaring robots break new ground during trial on the Great Barrier Reef. **25 July 2018. www.aims.gov.au**