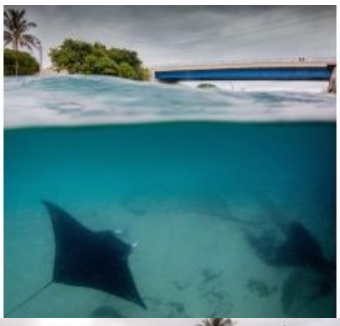
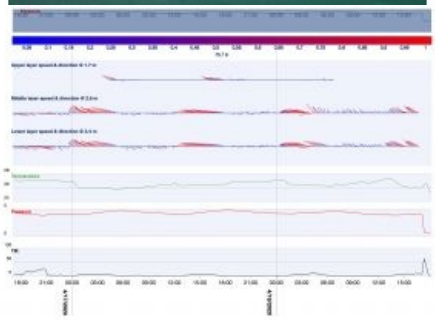
Uncovering the Secrets of Manta Ray Behaviour with a Mini ADCP





Understanding why marine animals are using some places and not others is crucial to minimizing our impact on them. Recently, the new Eco ADCP has been helping one marine biologist, with no previous experience in using oceanographic instruments, characterize current flows in one of the manta ray's more unusual shallow-water coastal habitats.

Powerful yet graceful, manta rays top almost everyone's list of must-see marine animals. While people flock to places like Indonesia or the Maldives to watch these gentle giants, one location has gone relatively unnoticed – South Florida.

"I lived in Florida working as a sea turtle biologist, and a lot of data collection involved being on the beach all day," recounts Jessica Pate, a marine biologist with the Marine Megafauna Foundation. "Sometimes I would notice these big, black shapes swimming right next to shore in less than a metre of water."

Surprised to see manta rays, Pate searched for more information but found very little. "I know hundreds of people researching sea turtles, and I couldn't believe that no one was studying manta rays [in South Florida]," she says.

Shallow Water with Strong Currents

With Florida's coast so highly developed, it is a surprising location for a nursery area. What's more, these particular 'urban manta rays' are also singling out some particularly hazardous locations. "There's this man-made inlet [Boynton Beach Inlet] that's known for being one of the most dangerous inlets because it's very skinny with seawalls, and boats come flying through. I try to avoid it at all costs," Pate says.

Despite the risks, and the shallow water (Pate estimates Boynton Beach Inlet's maximum depth to be around 10m), the inlet seems to be a popular location for the manta rays. "They will come around and face into the current, which is really strong, and just sit," says Pate, who sees groups of up to six manta rays sitting in the inlet for hours at a time.

A manta ray swims through the inlet. (Photo: Bryant Turffs)

Exchanging Floating Oranges

Pate knew that currents in the inlet are fast, but to properly characterize the flow she needed to be able to measure them. However, the costs of purchasing an ADCP quickly became a major roadblock. In search of alternatives, Pate started to consider other, much less accurate, options.

"I did an experiment with the drone, where I tossed oranges into the water with the hope of measuring the surface current," Pate says. Fortunately, when the Eco came along, Pate did not have to resort to oranges any more.

The Eco is designed with users like Pate in mind – those who are interested in understanding the physical nature of shallow-water environments but lack in-depth training or experience in using oceanographic instruments. Fitted with a transducer with a maximum profiling range of 20m, plus sensors for temperature, pressure, tilt and heading, the Eco offers such users a simpler, low-cost and user-friendly alternative to its larger, more heavily equipped sibling ADCPs.

“It was so easy to set up – all you do is go onto the online portal, input the time and date you want it to start recording, and deploy it,” says Pate.

Being just the size of a large coffee cup, the Eco is a natural fit for the shallows and is extremely portable – a feature which proved particularly useful when Covid-19 restrictions blocked access to the marina containing the boat Pate could use. Instead of using a boat, Pate’s boyfriend deployed the instrument using his stand-up paddleboard.

On a daily basis, current flow varied with the tide (stronger on an incoming tide). Currents in the lower and middle depth ranges varied much more than at the surface.

Effortless Processing of Current Measurement Data

Data collection is one thing, but for those like Jessica Pate who do not regularly work with oceanographic instruments, extracting the data and translating it into something meaningful can be a challenge.

For Pate, the deployment reports generated by the Eco were a boon. “It was pretty idiot-proof,” she says, explaining that generating the reports simply requires connecting the Eco wirelessly to a website and waiting for the report (and the raw data) to be produced.

“When I got the reports, I was very excited that [the software] put everything together for me instead of sending me a spreadsheet with a bunch of data that I didn’t understand,” says Pate, who was quickly able to identify some interesting patterns from the visualizations provided. “I learned that the surface current and the bottom current are not the same,” she recounts, noting that the bottom current is stronger than the surface current, on incoming tides, and with the full moon.

Using the Eco ADCP to Understand Manta Ray Habitat

For any at-risk species, protecting juveniles and their nursery areas is generally considered a must-do. For manta rays, which are listed as vulnerable to extinction by the International Union for Conservation of Nature, it is arguably vital. South Florida appears to be home to one of just three known manta ray nurseries in the world. “The manta rays are very young, so this is a really important habitat for them to safely develop into adulthood,” Pate explains.

With the Florida coast so highly developed and its coastal waters brimming with human activity, it is not surprising that accidents happen. “We see a lot of fishing line entanglement and vessel strike on the manta rays and other species,” says Pate.

Key to designing measures to reduce our impact on the young rays is understanding why they are using the places they are. “For NOAA, the federal government, to designate critical habitat, you have to identify the physical and biological characteristics of that habitat to be able to say why are they here, and not here,” Pate explains.

Jessica Pate’s work with the Eco on the inlet has revealed some of the secrets to the manta rays’ particularly hazardous habitat choice. Not only did she quantify the speed of the fast-moving current, but she also uncovered how the current varies throughout the inlet’s shallow water column, with tide, and with the lunar cycle.

To build up a complete picture of the manta rays’ habitat preferences, Pate would like to monitor other inlets to see if and when manta rays are using those, and measure current conditions in them just as she has done with the Eco in the Boynton Beach Inlet. Armed with such information, Pate hopes to raise awareness about the manta rays and work with the community to ensure that these urban manta rays will be with us for a long time to come.

The Ecoâ€™s small size came in particularly useful for deployment using a stand-up paddleboard. (Photo: Jessica Pate)