To Track a Sea Turtle

UNDERWATER VEHICLES FOLLOW TAGGED TURTLES IN THE WILD

by Ken Kostel

Courtesy of Amy Kukulya and Kara Dodge, Woods Hole Oceanographic Institution, under NMFS Permit No. 15672-02

A turtle-eye view of Martha's Vineyard Sound with the ferry in the distance. WHOI postdoctoral investigator Kara Dodge and engineer Amy Kukulya teamed up to adapt Kukulya's SharkCam autonomous tracking and imaging system to follow and film sea turtles in their natural environment.

Kara Dwyer Dodge grew up hearing stories of the sea monster her father pulled from the ocean.

In 1966, Richard Dwyer, a third-generation fisherman in Scituate, Mass., found a sea turtle entangled in the lines of one of his lobster pots. He freed it and brought it back to shore, where the turtle became a minor sensation because no one could remember ever seeing one so large so close to shore. After a couple of days, Dwyer took the turtle far offshore and released it in the Gulf Stream, where he thought it should be, rather than the waters near Cape Cod.

"No one knew then that this is part of their natural range," said Dodge.

Today, the daughter of a fisherman is a postdoctoral investigator at Woods Hole Oceanographic Institution, studying the behavior of sea turtles as a way to help prevent things such as entanglement in fishing gear. In 2013, she teamed up with WHOI engineer Amy Kukulya. With funding from The Discovery Channel, Kukulya and colleagues at WHOI's Oceanographic Systems Lab had built SharkCam—a system that used an autonomous underwater REMUS vehicle to track sharks in the wild. Kukulya joined biologists Greg Skomal from the Massachusetts Division of Marine Fisheries and Mauricio Hoyos Padilla at the Mexican marine conservation organization Pelagios Kakunjá to tag and follow nearly a dozen sharks in the waters around Cape Cod and Guadalupe Island, Mexico. Using SharkCam, they revealed previously unknown shark behaviors.

Courtesy of Kara Dodge

Kara Dodge's father, Richard Dwyer (center, with hat) found a leatherback turtle entangled in his fishing gear.

But tracking turtles turned out to be a much more challenging proposition. "We'd never put a suction-cup tag on an air-breather and followed it," said Kukulya. "They tend to yo-yo rather than follow a straight trajectory. We had to develop entirely new algorithms to follow a turtle."

To find funding for the research, they tried WHOI's new crowdfunding platform, ProjectWHOI, plunging into the fast-growing world of social media fundraising. The pair exceeded their $10,000 goal, raising $37,000 in two months from a combination of friends, family members, strangers, corporate donors, and a Falmouth High School art class, as well as WHOI Trustee Jean Tempel, who, among her many other interests, advocates on behalf of women in science and engineering. That nest egg allowed Kukulya and Dodge to collaborate with the Massachusetts Division of Marine Fisheries to win a $270,000 grant from the National Oceanic and Atmospheric Atmospheric Administration, which required matching funds.

"This happened because people believed in our approach to get out on the water locally and aid conservation," Kukulya

said. “It warmed my heart to see how dedicated people were to the turtles’ plight.”

With the funds, they were able to complete development of TurtleCam, including a redesigned tag with a custom-built release mechanism that Kukulya devised. In September 2016, they succeeded in tagging their first leatherback sea turtle and following it for more than six hours. That trip and three that followed resulted in a trove of video that Dodge is still combing through for insights that will help her help turtles navigate the many hazards that turtles encounter when they are near Cape Cod feeding on jellyfish.

She also has information from a second vehicle simultaneously deployed to gather data on biological productivity, as well as temperature and salinity at various depths near the tagged animals. “TurtleCam is great to collect fine-scale behavior, but we need as much habitat data as we can get to make sense of what we’re seeing,” said Dodge.

Kukulya is now refining the algorithm that controls TurtleCam to keep a turtle in the field of view longer and to better adapt the vehicle to a turtle’s behavior. This summer the two researchers will conduct five more trips around Cape Cod and offshore islands. Although many North Atlantic populations of sea turtles are stable, their primary threats—entanglement, boat strikes, plastics, coastal development, and climate change—are human-caused and not likely to diminish any time soon. Dodge only has to look to areas in the Pacific, where almost all sea turtle species are in trouble, to see how dire things could become.

“I’ve dissected a lot of dead leatherbacks,” said Dodge. “I don’t want to keep doing that.” ▲

From top: Kara Dodge and Amy Kukulya (inset) keep watch for sea turtles. Finding turtles isn't easy, because they present such a low profile on the water and spend a short time at the surface.

Kara Dodge tags a leatherback sea turtle. The tag stays on the turtle’s shell until Kukulya sends a coded acoustic signal that triggers a suction cup release mechanism that she designed.

Amy Kukulya and Kara Dodge prepare a REMUS autonomous underwater vehicle. Cameras on the tag let researchers record how much a turtle eats and how often it breathes, which allows them to calculate the animal’s metabolic rate and energy consumption.

Tagged leatherbacks typically dive to the bottom before resuming normal behaviors, including hunting for their favorite prey, jellfish (inset). The tags emit a coded acoustic signal that the REMUS vehicle can home in on. REMUS is programmed to follow the signal and anticipate the animals' movements, maximizing the time that turtles are in the field of view of one of its six cameras.