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Stanford's new surfing robot opens ocean to exploration

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A few days ago, Stanford marine biologists were excited to detect a white shark swimming along the California coast north of San Francisco. Although the biologists routinely monitor sharks, this particular moment marked the first step toward a "wired ocean" full of mobile robotic receivers and moored listening stations that can detect ocean wildlife as it swims by.

Although similar technologies have been used to monitor the ocean itself, specifically to investigate climate change, this is the first such experiment dedicated to wildlife.

In addition to providing researchers with near real-time data of sharks and other animals, the project supports a new iPhone and iPad app designed to give the public a more visceral connection to the ocean and the creatures within.

The Wave Glider robot – named Carey in honor of noted large pelagic fish biologist Frank Carey – is probing the Pacific Ocean off the California coast in an initiative led by Stanford marine sciences Professor Barbara Block and her research team to keep tabs on the comings and goings of top marine predators, and to provide better census data of all species in the area.

The Blue Serengeti Initiative, as the effort is called, picks up where the decade-long Tagging of Pacific Predators (TOPP) project left off. TOPP, an international collaboration among 75 scientists, involved tagging thousands of marine animals –great white sharks, elephant seals and leatherback turtles – and tracking their movements via satellite.

For example, TOPP revealed that great white sharks make seasonal migrations almost exclusively between Northern California and offshore waters called the White Shark Café, occasionally going as far west as the Hawaiian archipelago.

The seasonal gathering off North America's West Coast of animals as diverse as whites sharks, sea turtles, tuna, albatross and seals led Block and her colleagues to liken the California Current to Africa's Serengeti, a migration-heavy region long known to be critical to the sustainability of the animals that traverse it.

Part of the new effort relies on wiring up the regions Block and her team discovered during TOPP. This means getting listening stations in the water, and because the tags used in TOPP cost as much as $4,000, one of the first steps was choosing a less expensive technology for keeping track of the sharks long term. The team is now using $400 acoustic tags, each of which produces a unique series of "pings" to identify an individual animal as it swims by listening buoys.

There are now 120 white sharks carrying acoustic tags, along with 27 salmon sharks and five mako sharks. Other groups have tagged more animals – including salmon, sturgeon and lingcod – along the California coast with similar acoustic devices, which can also be picked up by the network of listening buoys.

Those buoys are moored in three foraging hot spots – Año Nuevo, the Farallon Islands and Tomales Point. These hot spots were known from ongoing photo ID studies by the team as well as the yearlong records from satellite tags that demonstrated the sharks' return with high fidelity. From now until late November, these three areas are plentiful with sea lions, seals and other prey that attract large numbers of white sharks. "These hot spots are like the Outback Steak Houses for white sharks," Block said.

The buoys can detect a shark's transmitter – or any animal with an acoustic tag – from as far away as 2,000 feet. The data is delivered in near real time to mobile devices; the whole process takes about four minutes.

Meanwhile, the unmanned wave glider Carey "surfs" up and down the coast, between the hot spots and to areas that are too remote for Block's group to visit on a regular basis. The device, built by the California-based company Liquid Robotics, consists of an underwater glider connected to a 7-foot-long "surfboard" that floats on the surface and carries scientific equipment. As the waves move the float up and down, it pulls the glider vertically. The glider's fins rotate to convert upward wave motion into forward thrust; as the float comes down off a wave, the glider sinks and the fins rotate in the opposite direction to generate forward thrust. This cyclical, nonstop action allows the glider to tow the float along a route set by the researchers.

Provided by Stanford University