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UH researcher Tim Tricas, left, and visiting undergraduate student Bond Segal look over the shark holding pond at Coconut Island in Kaneohe Bay, home of the Hawaii Institute of Marine Biology. Tricas and colleagues are studying sensors in sharks and butterfly fish that detect electromagnetic signals. Sharks might use the signals for navigation and tracking prey.

UH biologists tune in to sharks' sixth sense

By Helen Altonn
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University of Hawaii doctoral student Ariel Rivera-Vicente says he has counted 1,400 pairs of small sensory organs in a shark's head that can detect weak electric signals in the animal's environment.

much like branches of a large television antenna that can be seen on neighborhood rooftops, especially in the days before cable TV," said UH-Manoa zoology professor Tim Tricas, who spent seven months counting the sensory organs.

In Kaneohe Bay, for example, he said tidal motion causes an electric field in the water, and sharks "should be able to get information on which way the tide is coming from their electroreceptors, which might help them move in and out to feed."

The longer their electroreceptor canals are, the more sensitive they are, he said, comparing them to 1,400 pairs of television rabbit ears, all connected.

The 2,800 organs are grouped with half on the right side and half on the left side, said Rivera-Vicente, a National Institutes of Health fellow working with Tricas at the Hawaii Institute of Marine Biology at Coconut Island.

Tricas said scalloped hammerhead sharks have an exquisite array of sensory organs.

"Animals use this antenna array to locate electric sources, such as prey," Tricas said.

Tricas and his students are studying the behavior, sensory biology and ecology of juvenile hammerheads and sandbar sharks, as well as stingrays, which are closely allied.

His lab also has several projects on butterfly fish, including one at Puako Reef on the Big Island under a National Science Foundation grant.

What do sharks and butterfly fish have in common?

"We're interested in using natural systems to understand how the brain functions," Tricas said.

"The size of a shark's brain, relative to its body, is larger than many mammals and birds," he said. "These aren't simple animals." But the shark brain is poorly studied, he said.

Rivera-Vicente is proposing cutting-edge research to try to learn how the shark's brain encodes and processes electrosensory information, Tricas said. "Nobody else is doing it. He'll have the answer."

Tricas became interested in butterfly fish, which live on Hawaii's corals, while working on his doctorate degree in zoology at UH in 1986. His first faculty appointment was at the

Florida Institute of Technology, and he joined UH in 2000.

"This is the only lab in America, arguably, where you have direct access to coral reefs right outside your door," Tricas said.

He said his group has made the most progress studying the sensory cell arrays in dead sharks, determining where the neurons go in the brain and how the brain's road map is connected.

Each organ sends volumes of electrosensory information to the brain, and how the brain processes it for vision, touch and sounds is the big puzzle, he said.

In earlier research, Tricas and colleagues demonstrated that male stingrays use electrosensory information to locate female rays buried under the sand during mating season.

"We think males are very aggressive and bite females, and we think females are avoiding males by hiding under the sand."

Tricas said the National Institutes of Health gave Rivera-Vicente a five-year grant because it is interested in questions that ultimately deal with human health. "Organization of the brain may be useful," he pointed out.

In their Big Island project, Tricas and his students are investigating a novel hearing mechanism in butterfly fish -- an eardrum between the swim bladder, inner ear and lateral line that is not found in any other group of fishes. They discovered that butterfly fish communicate with sound, which suggests the structure might be used in social behavior, Tricas said.

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