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TRILOBITES

Scientists Finally Make Heads of Giant Stingray Tails

The long structures seen in manta rays and their relatives function as an early warning system, rather than a defensive weapon.

By Jack Tamisiea

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With hornlike facial fins and diamond-shape bodies that can stretch nearly 30 feet across, manta rays are among the strangest fish in the sea. Yet these behemoths' most puzzling feature is a whip-like tail that can measure as long as the rest of the fish's body.

Why mantas and related rays have such long tails has long been a mystery. The fish do not use their tails to propel through the water or to lash out at potential predators. And although stingray tails have a fearsome reputation for deadly stings, manta tails lack defensive spines entirely.

Instead, these elongated tails may act as fine-tuned antennae, specialized to detect approaching danger. In a paper published on Wednesday in the Proceedings of the Royal Society B: Biological Sciences, a pair of researchers analyzed tails belonging to cownose rays, a smaller relative of manta rays. They discovered that this elongated structure contained specialized organs that help sense underwater stimuli, hinting at how other oceanic rays may use their rear appendages.

“The complexity inside the tail was super surprising,” said Júlia Chaumel, a marine biologist at Harvard University and an author of the paper. “We had no idea that this huge structure had a sensorial function.”

While most stingray species reside near the seafloor, mantas and other rays in the myliobatid order spend most of their time in open water. These fish flap their enlarged, triangle-shaped pectoral fins to fly through the water and migrate over long distances.

According to Matt Ajemian, a researcher at Florida Atlantic University who studies sharks and rays, most stingrays have short, muscular tails that they use to flex venomous barbs. But myliobatid rays possess very different backsides.

“When you pick it up, it’s almost like a giant noodle, but in the water it’s very rigid,” said Dr. Ajemian, who was not involved in the new study. “Nobody really had a clue what these tails were being used for.”

To understand this anatomical feature, Dr. Chaumel and her colleague George Lauder took a closer look at the tails of cownose rays, a type of stout stingray with a double-lobed snout. They dissected the tails of several pickled specimens in the collection of the Museum of Comparative Zoology at Harvard. They also acquired two recently deceased rays. They created three-dimensional micro-CT scans of the tails, and cut thin slices to study the tissue structures.

The team discovered that the stiff tissue of a cownose ray’s tail was pockmarked with holes. The 3-D scans revealed that these holes were linked to the fish’s lateral line canal, a system of sensory organs found in fish and amphibians. The lateral line runs the length of the fish’s body and is connected to receptors in the fish’s skin to detect movements in the surrounding water.

In most aquatic vertebrates, the lateral line is most complex near the fish’s head, and becomes more

streamlined as it approaches the animal's tail. But in the cownose ray, the more complex system ran the length of the tail and branched off to connect to pores in the fish's skin.

The team posits that this network helps the rays' tails pinpoint stimuli in the surrounding water. This would be particularly handy when cownose rays descend to the seafloor to vacuum up burrowing bivalves. As they bury their heads in the sand, the rays are exposed to predators.

A fine-tuned antenna sticking out of their backsides would help the rays detect trouble before it was too late. "A shark coming in from behind would cause these huge movements of water, which lets the ray know it's time to zoom away," Dr. Chaumel said.

Dr. Ajemian agrees that it is plausible that cownose rays' tails act as antennae, which is somewhat surprising because his team encounters rays with damaged or missing tails in the wild. "We thought the tail was something that could easily be shed," he said.

Dr. Chaumel thinks there's more to the tail than just early warnings. Her team is analyzing other species, including manta rays, to see if these structures help steady these fishes as they swim, like the tail of a kite.

A version of this article appears in print on , Section D, Page 2 of the New York edition with the headline: Early Warning System: In the Tails of Giant Stingrays, Signals of Trouble Ahead