Proteins in shark teeth could hint at what they eat

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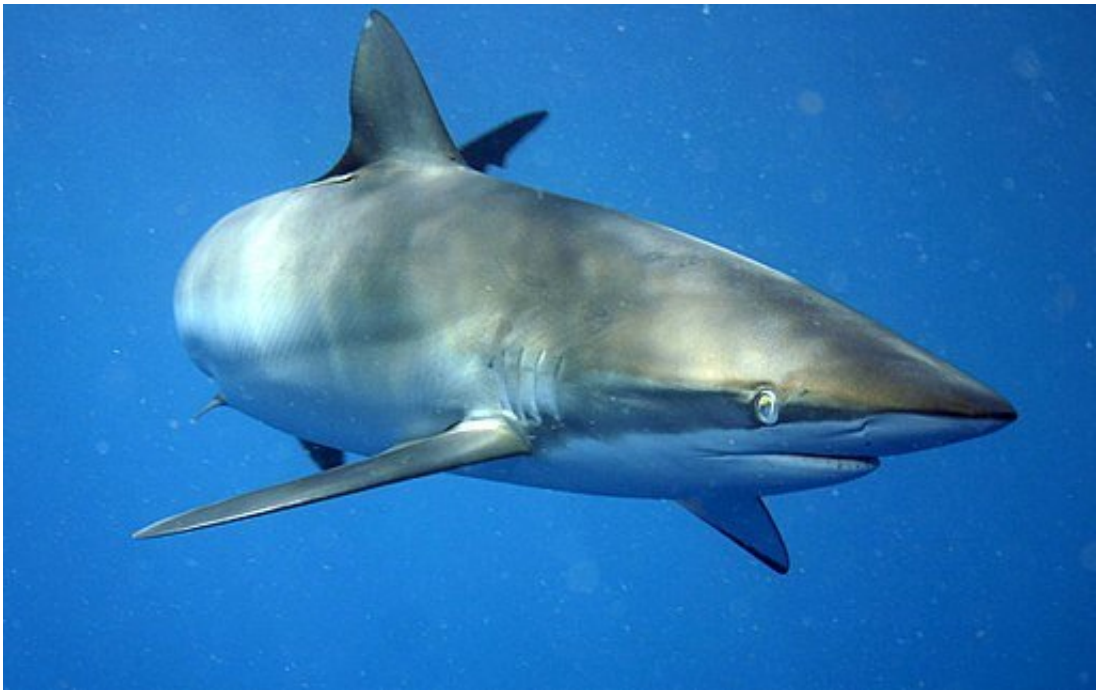

The silky shark (Carcharhinus falciformis) is named for the smooth texture of its skin, and can be found in tropical waters around the world. Credit: Alex Chernikh

Certain molecules found in shark teeth proteins could tell scientists how the predators are connected to other animals in the food web, according to new research.

Sharks are top predators in their environments, so their health represents

the health of the animals they feed on. Understanding what sharks eat, and therefore their relationship to other animals in the food web, helps researchers determine how well that ecosystem is doing and identify any ecological changes going on, such as depletion of prey species.

Amino acids are the building blocks of proteins. Scientists can determine where sharks fit into the food web by measuring ratios of different types of nitrogen atoms in amino acids in shark muscle tissue. Certain amino acids accumulate in predictable amounts as they travel up the food chain. But using soft tissue like muscle to analyze a shark's diet can be tricky, because researchers must collect and store the tissue properly.

But researchers from the University of Southern Florida have found that shark teeth can provide the same feeding information as muscle without the hassle of preserving soft tissue. This allows scientists to learn how sharks' positions in the food web have changed over time by using teeth stored in museum and archaeological collections. The researchers presented their work Monday at the 2017 American Geophysical Union Fall Meeting in New Orleans.

Teeth are like muscle, except for one thing

The research team collected teeth and muscle tissue samples from preserved specimens of silky, blacktip, and tiger sharks from the Fish and Wildlife Research Institute in Florida. They used acid to extract collagen proteins from the teeth and soft tissues. Then they separated the collagen proteins into individual amino acids.

Tiger sharks get their name from the dark strips on their bodies, which fade with age. Researchers measured nitrogen isotopes in teeth and muscle from tiger sharks, blacktip sharks, and silky sharks. Credit: Albert Kok

The researchers then measured the ratio of different types of nitrogen atoms called isotopes in each amino acid. They did this for eight amino acids known to continue through each step of the food chain in predictable amounts.

They found the ratio of nitrogen isotopes were very similar in muscle and teeth for all amino acids except for one – phenylalanine. Phenylalanine is an amino acid that, through biological pathways, gets converted into certain neurotransmitters like dopamine and epinephrine.

"For some reason, we're seeing [phenylalanine] really enriched in the

teeth," said Matthew Hayes, a geochemist at the University of South Florida in Tampa, Florida, who presented the research.

The researchers aren't sure why phenylalanine is so much higher in teeth compared to muscle. Hayes and his team haven't discounted the possibility that the difference is due to an issue with the sample processing, but they're doubtful that's the case since all other amino acids they looked at were so similar between teeth and muscle tissue for these species.

"It's either a fluke, or there must be something really interesting going on with teeth and the nitrogen cycle," said Alexandra Atlee Phillips, geochemist at the California Institute of Technology in Pasadena, California who was not connected to the research.

Despite the phenylalanine difference, their research shows that nitrogen isotopes associated with amino acids in teeth can be used to understand a shark's diet and position in the food web.

The team plans to expand their research by examining more samples and other species. "We're going to test an entire row of shark teeth, and we've got a number of other fish teeth that we're going to run through the processes as well," Hayes said.

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