FEEDING ECOLOGY, DIET, AND NUTRITION IN WHITE SHARKS (*CARCHARODON CARCHARIAS*) IN THE WESTERN NORTH ATLANTIC

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Abstract

Sharks are important apex predators that help manage the balance of the ocean ecosystems through top-down pressures influencing species abundance and ecological community structure. Shark populations have declined drastically over the past several decades due to overfishing, bycatch, finning, poaching, and climate change. Because of the collapse of many shark populations, numerous fish stocks have become unbalanced leading to disruptions in lower food webs. This has global consequences as it can affect human food supply, resources, and economics in an ever-growing population. Understanding the feeding ecology and diet of sharks is important for evaluating the consequences of their absence which can help leverage policy and management decisions to better protect these species.

White sharks (*Carcharodon carcharias)* are large, elusive, solitary species that are difficult to work with due to their size, low population, and safety risks. They are considered vulnerable under the International Union for the Conservation of Nature (IUCN) Red List of threatened species. Due to limited access to these animals, a paucity of data remains surrounding their biology and physiology, including feeding ecology and diet, which is often limited to observations of predation at the surface.

Reconstructing diets in sharks has traditionally relied on visual identification of prey remains within stomach contents, either during post-mortem evaluation or through the process of gastric lavage. These techniques are often biased toward hard-parts remaining in the gut and require either animal sacrifice or invasive techniques. Reliable access to blood and muscle tissue and fecal samples allow for the less-invasive examination of feeding ecology through fatty acid signature analysis and the determination of diet through DNA metabarcoding techniques. Fatty acid (FA) profiles offer a non-lethal, minimally invasive technique to evaluate prey consumption given that long chain FAs pass from prey to carnivore consumers relatively unchanged, allowing for the reflection of a prey's FA profile to be represented in the tissues of the consumer. In addition to dietary information in elasmobranchs, FAs can also provide information on bioenergetics, body condition, life history, and physiology. Similarly, the use of molecular diagnostic tools to sequence prey DNA from fecal samples with generic and species-specific mitochondrial DNA primers allow for the precise identification of a recently consumed diet.

The goal of this project is to better understand feeding ecology, diet, and nutritional health of white sharks. Research expeditions were conducted aboard the M/V OCEARCH, which serves as an at-sea laboratory. The M/V OCEARCH offers a 75,000 lb. capacity hydraulic platform designed to safely lift mature marine animals out of the ocean for sample collection and tagging. This project examined FA profiles in blood plasma and DNA in fecal samples collected from white sharks (*Carcharodon carcharias*) within the Western North Atlantic population to evaluate dietary

difference across life history stages and geographic regions. Preliminary results provide insight into the feeding ecology of white sharks and demonstrate the utility of FAs as biomarkers of diet.