

Data Modeling Reveals Tiger Shark Migrations, May Explain Hawaii Attacks

University of Florida



GAINESVILLE, FL -- The migration of mature female tiger sharks during late summer and fall to the main Hawaiian Islands, presumably to give birth, could provide insight into attacks in that area, according to a University of Florida scientist.

In a new seven-year study, researchers from UF and the University of Hawaii used new techniques to analyze the predators' movements in the Hawaiian archipelago, where recent shark incidents have gained international attention, including a fatal attack in August. The study revealed different patterns between males and females – less inter-island movement was seen in males, while about 25 percent of mature females moved from the remote French Frigate Shoals atoll to the main Hawaiian Islands during late summer and early fall. The peer-reviewed authors' manuscript is available online and tentatively scheduled to appear in the November print issue of *Ecology*.

"We have previously analyzed data to see which sharks are hanging around shark tours with cage divers on Oahu, and one of the things we noticed was that you'd get a spike in how many tiger sharks are seen in October, which would match our predicted model that you're having an influx of big, pregnant females coming from the northwestern Hawaiian Islands," said Yannis Papastamatiou, a marine biologist in the division of ichthyology at the Florida Museum of Natural History on the UF campus. "There even tends to be a spike in the number of shark bites that occur during that season."

The current study focused on migration patterns and not human-shark interactions, but data from the International Shark Attack File housed at the Florida Museum

show Hawaii had 10 reported attacks in 2012. This year eight reported attacks have occurred, and the August fatality was the state's first since 2004. Since 1926, the highest numbers of reported attacks in Hawaii occurred in October, November and December.

"We knew tiger sharks had fairly complicated movement patterns and it seemed to be sort of a free-for-all," said Papastamatiou, who studied sharks as part of his doctorate research at the University of Hawaii. "Once we looked at data for the full seven years and used the right analysis, everything started to make sense. Now we have a much better understanding of the migration patterns of these sharks."

The data modeling, which was developed by UF graduate student and study co-author Felipe Carvalho, shows only a portion of the population migrates at one time and there is a higher probability for females to arrive on the main Hawaiian Islands between September and October. Scientists tagged more than 100 tiger sharks since 2004 and collected data using passive acoustic telemetry. Sharks were recorded swimming within proximity of receivers placed at every island in the Hawaiian archipelago, which spans about 1,500 miles.

"We believe approximately one-quarter of mature females swim from French Frigate Shoals atoll to the main Hawaiian Islands in the fall, potentially to give birth," Papastamatiou said. "However, other individual sharks will also swim to other islands, perhaps because they are trying to find a more appropriate thermal environment, or because there may be more food at that island. So, what you see is this complex pattern of partial migration that can be explained by somewhat fixed factors, like a pregnant female migrating to give birth in a particular area, and more flexible factors such as finding food."

Researchers used satellite information that tracks when the sharks reach the surface to confirm horizontal movements. They also investigated environmental circumstances, resource availability, first-hand observations and data collected from previous studies to better understand varying conditions and validate their results.

Christopher Lowe, a professor in the biological sciences department at California State University Long Beach who was not involved with the study, described the co-authors' data analysis as innovative. Lowe said the study confirms the importance of continued long-term monitoring to provide vital data for resource management.

"At least now we have an inkling as to how males and females behave differently and how these behaviors vary with resource changes or environmental changes," Lowe said. "It gets us a step closer to the ability to better understand why incidents occur."

Tiger sharks are found worldwide in tropical and subtropical waters. As adults, they are one of the largest predatory fishes in the ocean, and mature females most likely give birth every three years. Because tiger sharks tend to be near the top of the food chain, they play a large role in other animals' behavior. They also have one of the broadest, most general diets of any shark, Papastamatiou said.

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"When you think of migration patterns, you think of all the animals in a population getting up at a certain time and migrating somewhere else, and then they all come back together – so everybody does the same thing," Papastamatiou said. "But that's actually rarely how it happens."

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