Pregnant shark birth tracking technology provides key data for species protection

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Insertion of the Birth-Alert-Tag (BAT) via a specialized applicator into the cloacal opening of a pregnant tiger shark. Credit: Tanya Houppermans / Blue Elements Imaging

Most people find sharks threatening. Who doesn't have an image in their mind of a menacing shark fin racing through the ocean in search of its next meal?

But it is the shark that is threatened.

According to Defenders of Wildlife, a national nonprofit dedicated to protecting imperiled species, 75% of shark species are threatened with extinction and up to 73 million sharks are being killed each year for their fins.

Habitats that were once secure places for sharks to give birth have also been affected. And the fact that sharks have long gestation periods, giving birth to relatively few young, and maturing late in life—complicates efforts at repopulation. And that's a problem.

In a new paper published today (March 1) in *Science Advances*, authors James Sulikowski, a professor at Arizona State University and Neil Hammerschlag, a marine ecologist at the University of Miami, describe a new technology they developed capable of remotely documenting the location and time of birth of shark pups. This type of data will enable scientists to create ways to protect the sharks' most vulnerable habitats, where they give birth.

"If they (the mother sharks) don't have that suitable habitat, then their babies won't be able to grow up. And if babies don't grow up, we have no more sharks and literally, the ocean ecosystem would collapse," explained James Sulikowski, senior Global Futures scientist at Arizona State University and director of the Sulikowski Shark and Fish Conservation Lab at ASU's New College of Interdisciplinary Arts and Sciences.

Image of the Birth-Alert-Tag (BAT). Credit: James Sulikowski

The device is making waves in the scientific community—and for good reason.

"We've been trying to do this since we started studying sharks. This is our holy grail. We have really advanced shark science, 20, 30, 40 years," said Sulikowski. "This novel, satellite-based technology will be especially valuable for the protection of threatened and endangered shark species, where protection of pupping and nursery grounds is a conservation priority."

The paper outlines the deployment and results of an intrauterine satellite tag on two highly mobile sharks—a scalloped hammerhead and a tiger

shark—to detect when birth occurs, leading to its name, birth-alert-tags (BAT).

Here's how BAT works.

First the BAT is inserted into a pregnant shark. The egg-shaped technology is approximately 2 inches long and 1 inch wide. When the shark gives birth, the BAT pops out along with the pups and reaches the ocean surface. Once there, the device switches to transmitter mode sending messages announcing the time and location of the birth.

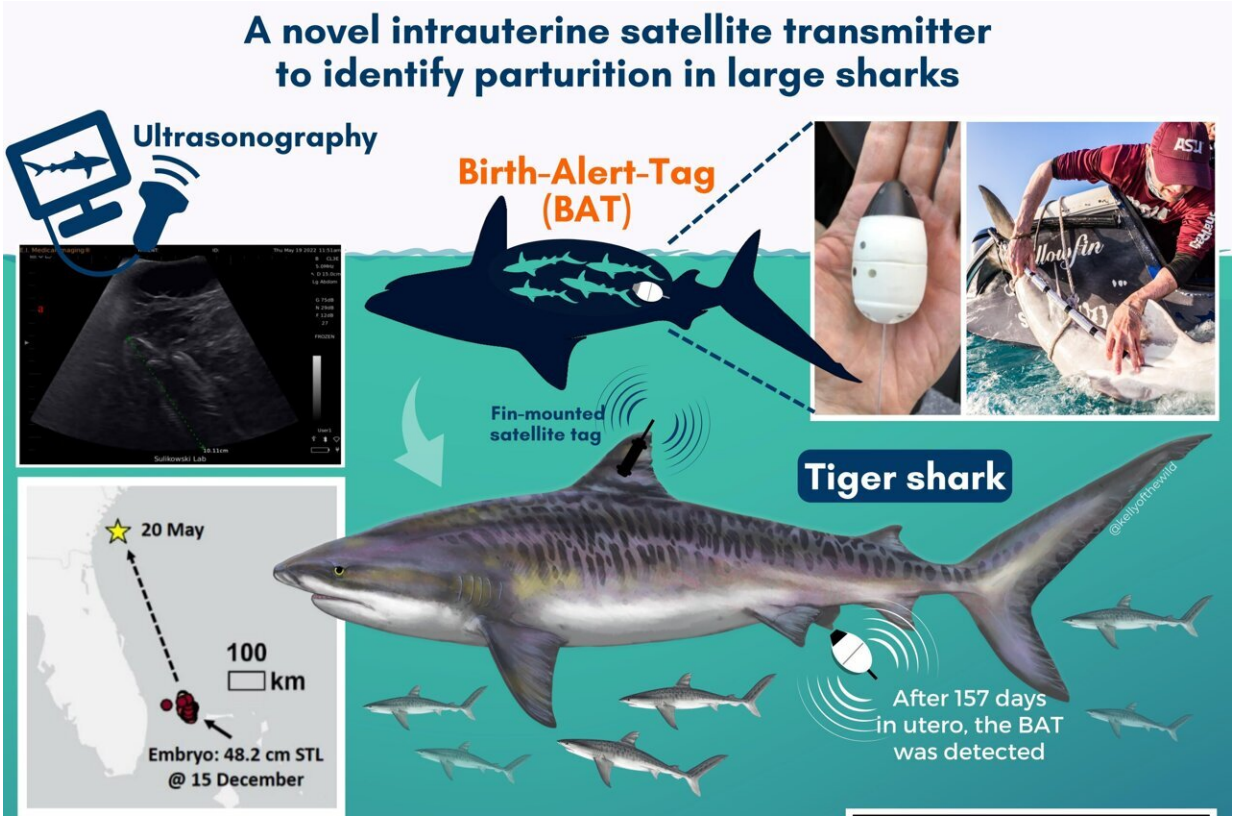
The BAT has already yielded remarkable results. Where it was once assumed that sand sharks gave birth inland, the scientists have learned that they are most comfortable having their pups in abandoned shipwrecks on the ocean floor.

"It was a total surprise," Sulikowski said. "For most shark species we have no idea where they give birth or how far they must travel to habitats that are essential to their survival."

Once habitats are discovered, efforts will be made to protect those areas, either by creating sanctuaries or expanding areas already set aside for this purpose.

The ultimate goal is to go global with the BAT.

Sulikowski wants to create a worldwide network of shark scientists to determine areas that are important to sharks and figure out how to protect them.



In a new study, researchers used new technologies to remotely document, for the first time in the wild, the location and timing of shark birth. Ultrasounds were used to identify pregnant sharks. During pregnancy in sharks, the entrance to the uterus remains semi-permeable to allow for water exchange between the uterus and outside. So, with the aid of a specialized applicator and guided by the ultrasound, the team inserted a new type of satellite tag through the shark's cloaca (akin to a vaginal opening) and into its uterus, where the tag was then deposit among developing embryonic sharks. Named the Birth-Alert-Tag (BAT), this new satellite tag remained inside the uterus, along with the developing shark pups, until the mother shark gave birth and expelled the newborn pups, along with the BAT, into the surrounding water. The BAT then floated to the surface and transmitted to satellites the location of where the shark birth took place. The first of its kind, the BATs were successfully deployed in a tiger shark and scalloped hammerhead shark, documenting the location birth. Credit: Infographic by Bianca Rangel. Shark by Kelly Quinn / Canvas of the Wild.

Persistence pays off

Sulikowski is enjoying his current success. "We've had every sort of failure that can happen," he said. "We had battery failures. We had firmware failures, we had antenna failures. I felt like giving up multiple times. But thanks to my co-author, Neil Hammerschlag, we kept forging ahead and we didn't give up."

"Honestly, it feels incredible to have created technology that is going to revolutionize the way that we study sharks," Sulikowski added.

More information: James Sulikowski et al, A novel intrauterine satellite transmitter to identify parturition in large sharks, *Science Advances* (2023). DOI: 10.1126/sciadv.add6340. www.science.org/doi/10.1126/sciadv.add6340

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