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Counting **great white shark** populations using **DNA**

Love them or fear them, great white sharks are iconic members of oceanic ecosystems. Strong populations of top predators like white sharks are integral to the health and integrity of these ecosystems, but interactions with people often complicate conservation efforts. Keeping an eye on wild shark populations is a necessary part of their conservation, and a project involving cutting-edge analysis using great white shark genetic information provides a unique opportunity to monitor them.

South Africa's great white sharks present a unique case study of the complicated politics surrounding human-wildlife interactions. In the 1940s, large numbers of shark attacks on swimmers on the beaches of Durban caused economic turmoil as tourists opted to stay away from the area's beaches. To protect both the lives of swimmers and the area's tourism economy, the government established the KwaZulu-Natal Sharks Board (KZNSB) to maintain a series of shark nets and drumlines installed along the South African coast to keep sharks from interacting with swimmers. Though controversial, these worked: shark attacks plummeted and tourists returned to the beaches.

Population tracking

Tracking how white shark populations change over time is necessary for conservation. Measures to protect swimmers, such as the shark nets maintained by the KZNSB, are a fine trade-off between the public desire for accident prevention and the conservation of healthy shark populations and although the number of attacks has decreased since their implementation, the effect these nets have on shark populations is unknown.

In the past, population estimates of the region's white sharks have relied on a method called "mark-recapture", where the sharks are physically tagged, released, and re-caught at a later time to produce population estimates.

In South Africa, the first study of this kind used dart tags to mark adult sharks, whereas others have used unique dorsal fin markings as 'tags' to estimate population size. These methods are well-established in wildlife conservation but require extensive field work, which make them expensive to implement and use in the long term. Without a cost-effective way to monitor shark populations, it's difficult to maintain the trade-off between the public desire for accident prevention and the conservation of sustainable shark populations in South Africa.

However, sharks caught by the nets and drumlines provide a unique opportunity to implement a new population

monitoring method that uses the DNA of those caught individuals.

DNA tracking

In collaboration with the KZNSB, researchers at the University of Washington's School of Aquatic and Fishery Sciences (Seattle, USA) are using a technique called "close-kin mark-recapture" (CKMR) to estimate the population size of great white sharks from only a small piece of its fin. In contrast to traditional mark-recapture studies, a close-kin mark-recapture analysis relies on genetic "tags" to identify related pairs that tell us something about how large their population is.

When a shark is caught in a net, a piece of its fin is collected and preserved. Then, using molecular laboratory techniques, each individual shark's unique genetic code is determined from the DNA contained in its fin tissue.

Individuals that are related to each other (either as parent-offspring or sibling pairs) can then be identified from this genetic information.

The number of pairs that are identified from a sample of sharks tells us a lot about how big the population is that they came from. If the shark population is large, you would expect a relatively small number of related pairs in your samples, as there would be many individuals who don't interact and interbreed with each other.

Similarly, if the population is small, you would expect a relatively large number of related pairs as there is a higher chance that each shark interbreeds with each other.

The benefit of this method is that each shark only has to be sampled once and does not need to be encountered again, reducing long-term costs of population monitoring. This presents a unique opportunity to use animals caught in the nets and drumlines to contribute to the conservation of the species: as additional samples are collected, they can be sequenced, added to the existing genetic data already collected, and used for population monitoring. So this project uses genetic information from routinely collected fin clips to provide the necessary information.

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This way, less intensive field work is needed, and scientists and authorities can more easily monitor great white shark populations to protect both people and sharks.

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