

Mediterranean great white sharks found to have 3.2 million-year-old origins

February 11 2020



Historical Great White Shark jaws front. Credit: University of Bologna

The great white shark has been in the Mediterranean for 3.2 million years, way longer than researchers have hypothesized until now. The white sharks currently living in the Mediterranean are genetically closer to those of the Pacific Ocean than to their neighbors inhabiting the Atlantic.

Starting from the analysis of artifacts and ancient trophies kept in museums, a research group led by the University of Bologna managed to sequence the DNA of Mediterranean white sharks. Their approach combines genetics and mathematical models and proved to be effective in tracing back their peculiar evolutionary history. However, researchers also warn that they might become extinct. Their study will be published on the *Journal of Biogeography*.

"White sharks have a complex evolutionary history, they are unusual. They evolved into sedentary populations scattered around the globe. Among these, there are the Mare Nostrum white sharks, which are really unique," explains Agostino Leone, researcher at the University of Bologna and first author of the study. "White sharks in the Mediterranean have a very low genetic variability, which may hint at a very small and endangered group of sharks."

DNA and historical artifacts

The great white shark (*Carcharodon carcharias*) is the largest predatory fish on earth, with larger individuals growing over six meters in length and one ton in weight. They're found off the shores of South Africa, Australia, New Zealand, Japan and North and South America, and, of course, of the Mediterranean. Despite being VIPs in the animal realm,

starring in blockbuster movies like Spielberg's "Jaws" and in many documentaries, scientists know little about their history.



Historical Great White Shark jaws lateral. Credit: University of Bologna

In particular, Mediterranean white sharks have been under-studied because over the last century, their [population](#) has decreased, making it hard for researchers to analyze them. The researchers of this study tried to overcome this issue by turning to museums and private collections of historical artifacts such as teeth, jaws and vertebrae from over the past two centuries. Thanks to the most recent genomic technologies, researchers were able to sequence the mitochondrial DNA of a number of Mediterranean white sharks and then compare it with other populations of sharks living elsewhere.

"This new data allowed us to observe the biological diversity of white sharks living in the Mediterranean," said Agostino Leone. "By analyzing and comparing different specimens, we were able to estimate that the white shark population in the Mediterranean started to evolve differently from other cognate populations around 3.2 million years ago. This essentially proves that those theories about sharks colonizing the Mediterranean around 450,000 years ago are wrong."

From the Pacific Ocean to the Mediterranean Sea

The origins of Mediterranean white sharks are further in the past than previously thought. This finding allowed the researchers to confirm that these white sharks are more related to those inhabiting the Pacific Ocean than those living in the Atlantic Ocean. This similarity can only be explained by tracing back the predator's colonization path through the oceans.

According to the researchers, Mediterranean white sharks originated from those of the Pacific Ocean. The latter traveled across the Atlantic through the Central American waterway, before the Isthmus of Panama was formed, and they eventually reached the Mediterranean Sea. 3.5 million years ago, the formation of the Isthmus of Panama blocked the waterway between North and South America. This brought a series of

drastic changes in the climate of the Atlantic Ocean, and as a result, many fish species became extinct. The white shark might have been among them. Therefore, the Atlantic Ocean underwent a relatively recent re-population of white sharks, perhaps because of white sharks' migration waves from South Africa, hence the genetic difference between them and the Mediterranean white sharks.



Historical Great White Shark jaws in laboratory. Credit: University of Bologna

Finally, the study on Mediterranean white shark DNA brings forth a worrying result: the low degree of genetic variability between different individuals of the species. This suggests that the white shark population

is quite small, and thus endangered. "The Mediterranean population of [white sharks](#) is probably a small endangered community," says Agostino Leone. "To save them, it is fundamental to act quickly: Their extinction would be detrimental to the ecological balance of the Mediterranean Sea as well as to the already highly unstable global situation of these majestic sea predators."

The study, titled "Pliocene colonization of the Mediterranean by [great white shark](#) inferred from [fossil records](#), historical jaws, phylogeographic and divergence time analyses," will be published in the *Journal of Biogeography*.

More information: *Journal of Biogeography*, "Pliocene colonization of the Mediterranean by Great White Shark inferred from fossil records, historical jaws, phylogeographic and divergence time analyses".

Provided by University of Bologna

Citation: Mediterranean great white sharks found to have 3.2 million-year-old origins (2020, February 11) retrieved 2 May 2024 from <https://phys.org/news/2020-02-mediterranean-great-white-sharks-million-year-old.html>

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