Sharks have depleted functional diversity compared to the last 66 million years, study finds

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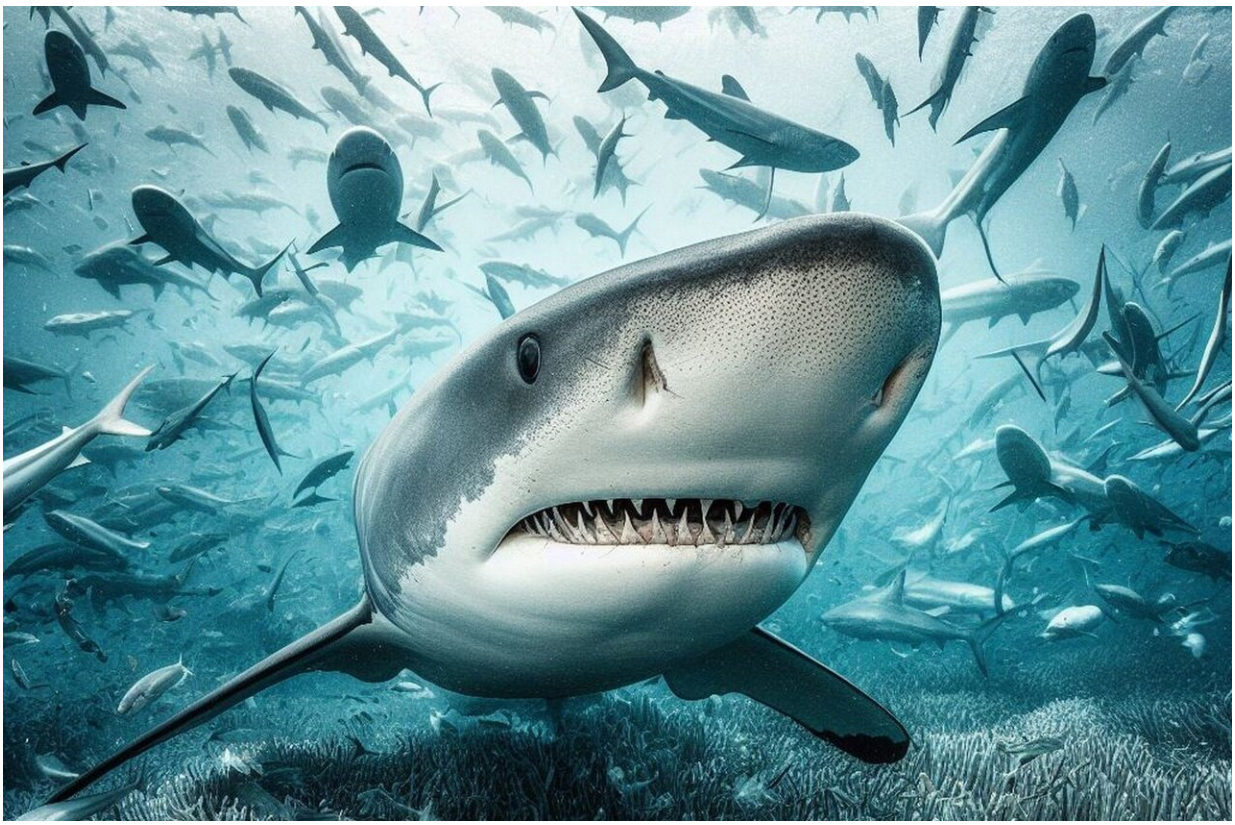

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New research by Swansea University and the University of Zurich has found that sharks retained high levels of functional diversity for most of

the last 66 million years, before steadily declining over the last 10 million years to its lowest value in the present day.

The study is published

in *Global Ecology and Biogeography.*

Modern sharks are among the ocean's most threatened species, yet have notably survived numerous environmental changes in their 250-million-year history. Today, more than 500 species play many different ecological roles, from

apex predators to nutrient transporters.

Ecological roles are determined by species' traits such as body size, and what and how they eat. As such, measuring the diversity of these traits allows scientists to quantify the range of ecological roles in a community, also known as functional diversity.

Since sharks possess soft cartilaginous skeletons unlikely to fossilize, these traits are difficult to measure directly in extinct species. However, measurements from their teeth, which are hard and therefore, well-preserved in the fossil record, can act as trait proxies, which can in turn be used to quantify functional diversity in the geological past.

Lead author Jack Cooper, a Ph.D. student at Swansea University, said, "Measurements like tooth size, shape, and types of edges broadly reflect a shark's functional traits such as body size and diet, allowing us to assess their functional diversity through time."

The researchers measured more than 9,000 fossil and living shark teeth from around 500 species, gathered from museum collections and literature, and quantified functional diversity over the Cenozoic era,

from 66 million years ago to the present day.

They found that sharks maintained high levels of functional diversity—meaning a wide range of ecological roles—for most of the Cenozoic era. This diversity peaked about 20 million years ago in the Miocene epoch. However, they also found that after this peak, the extent of shark ecological functions has been steadily declining for the last 10 million years, with present-day shark functional diversity being lower than at any point in the last 66 million years.

By quantifying ecological contributions of individual species, the researchers determined that the observed decline was driven by the loss of ecologically unique and specialized species. Such losses included the extinction of the megalodon, the largest shark that ever lived, which was an apex superpredator, an ecological role not played by any shark living today.

He added, "Not only did we see a clear decline in functional diversity, but we also found that extinct sharks as a whole contributed a wider range of ecological roles than living sharks."

The results ultimately warn that human threats like overfishing, which is driving today's sharks towards extinction, are likely further eroding the already diminished ecological contributions of sharks to ecosystem functioning.

Senior author Dr. Catalina Pimiento, Professor at the University of Zurich and senior lecturer at Swansea University, said, "By identifying the modern species holding some of the Cenozoic functional space, our study could potentially complement conservation priorities for the preservation of shark functional diversity in our changing world."

More information: Jack A. Cooper et al, The rise and fall of shark

functional diversity over the last 66 million years, *Global Ecology and Biogeography* (2024). DOI: 10.1111/geb.13881

Provided by Swansea University