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Biological responses of sharks to ocean acidification

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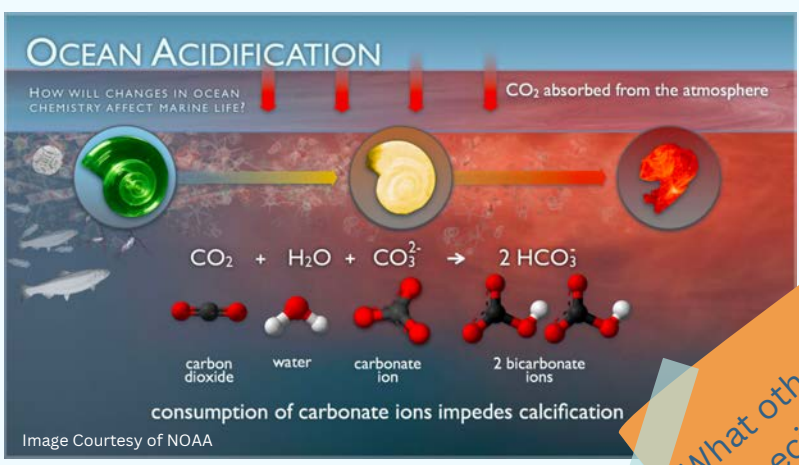
Abstract

Sharks play a key role in the structure of marine food webs, but are facing major threats due to **overfishing** and habitat degradation. Although sharks are also assumed to be at relatively high risk from climate change due to a low intrinsic rate of population growth and slow rates of evolution, **ocean acidification (OA)** has not, until recently, been considered a direct threat. New studies have been evaluating the potential effects of end-of-century elevated CO₂ levels on sharks and their relatives' **early development, physiology and behaviour**. Here, we review those findings and use a **meta-analysis** approach to quantify the overall direction and magnitude of biological responses to OA in the species of sharks that have been investigated to date. While **embryo survival** and **development time** are mostly unaffected by elevated CO₂, there are clear effects on **body condition, growth, aerobic potential and behaviour** (e.g. lateralization, hunting and prey detection). Furthermore, studies to date suggest that the effects of OA could be as substantial as those due to warming in some species. A major limitation is that all past studies have involved relatively sedentary, benthic sharks that are capable of **buccal ventilation**—no studies have investigated pelagic sharks that depend on **ram ventilation**. Future research should focus on species with different **life strategies** (e.g. pelagic, ram ventilators), **climate zones** (e.g. polar regions), **habitats** (e.g. open ocean), and distinct **phases of ontogeny** in order to fully predict how OA and climate change will impact higher-order predators and therefore **marine ecosystem dynamics**.

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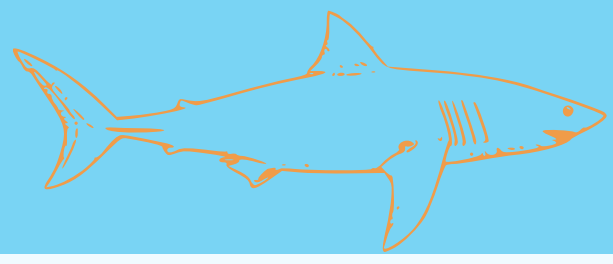
What other marine species do you think are affected by ocean acidification?

Summary

Sharks are extremely important to our oceans ecosystems and food webs, but their populations are threatened by overfishing and habitat loss. Another risk that sharks, and many other animals, face is climate change, but up until recently, scientists haven't considered ocean acidification (which is an effect of climate change) a direct threat to sharks. Recent studies have investigated the effect of increased CO₂ levels and temperatures on sharks and their relatives' early development, bodily functions, and behavior. This team of scientists decided to compile data from multiple studies on this topic for a meta-analysis on the subject. They want to know how much the species that have been studied so far are being impacted by higher CO₂ levels and ocean acidification. By reviewing the previous studies, they found out that while elevated CO₂ levels do not cause many issues with embryo survival and development, it did have impacts on how the shark grows, breathes, and finds food. In the future, scientists should investigate further by studying different species that live different lifestyles in different habitats so we can better understand and predict how ocean acidification and climate change impact our ocean's top predators.



Why might there be a difference in effects on an embryo compared to a juvenile or adult shark?



Check Your Understanding

We determined that climate change and ocean acidification can directly harm sharks. What other treats do sharks face?

How does increased CO2 in the water hurt shark populations?

Why is it important to keep doing research on sharks and climate change?

What can you do to protect sharks and our planet?

Glossary of Key Terms

Climate change- a change in the average conditions, such as temperature and rainfall, in a region over a long period of time

Ocean acidification- change in the properties of ocean water where the ocean becomes more acidic from absorbing carbon dioxide from the atmosphere

Overfishing- the act of taking out too many fish and other marine animals from the ocean.

Habitat loss- destruction of an area where plants and animals live

Behavior- how a shark acts when it finding food and avoiding getting eaten or anything else the shark does

Physiology- how a shark's body functions and how it interacts with its environment