Ocean Acidification: The Other Carbon Dioxide Problem

Key results from the German Research Network BIOACID

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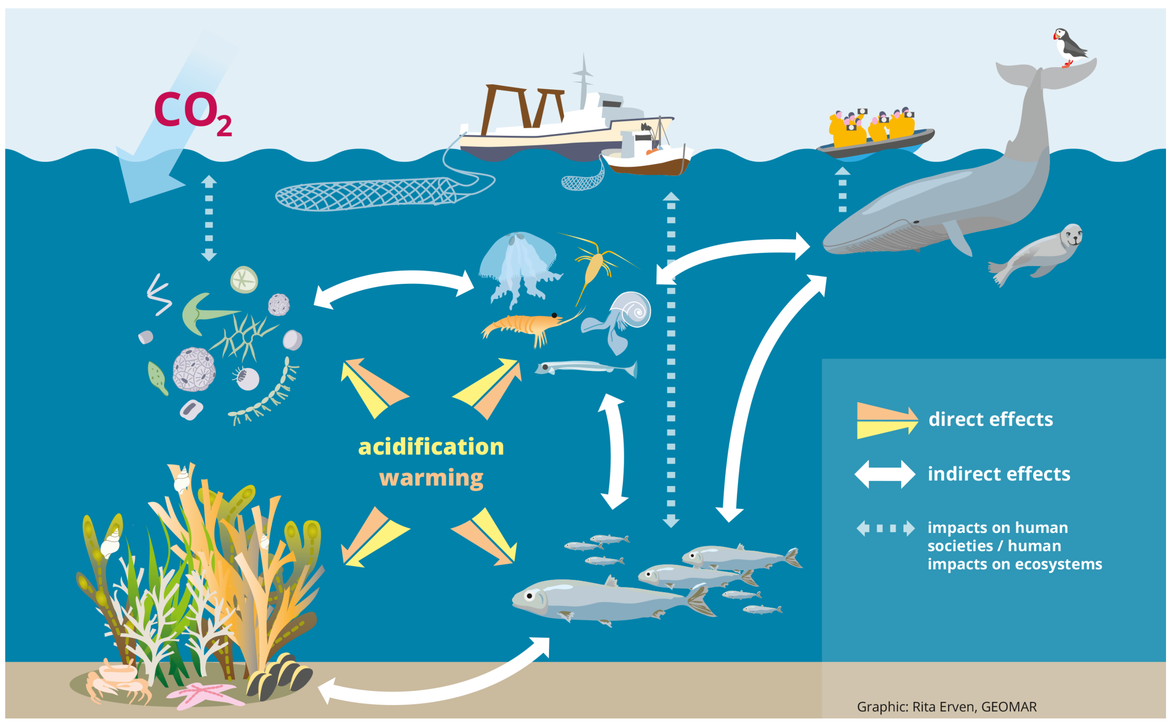
Exploring Ocean Change

By taking up carbon dioxide (CO_2) from the atmosphere, the ocean slows down global climate change. But when absorbed by seawater, the greenhouse gas triggers chemical reactions, causing the ocean to become more acidic. Ocean acidification and warming affect the diversity of marine life as well as important services the ocean provides to ecosystems and humankind.

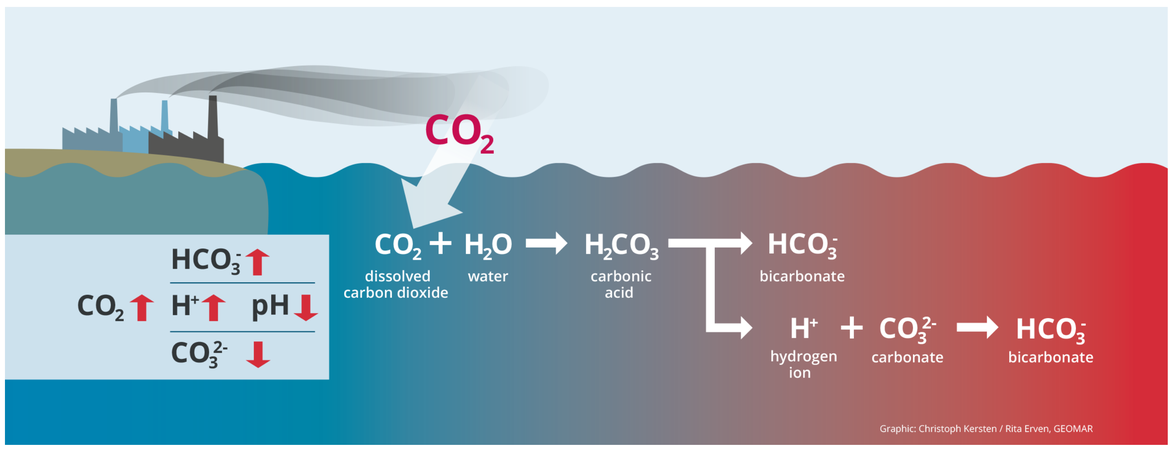


Ocean acidification and warming are able to affect organisms directly and amplify or attenuate each other's effects. Reactions of individual species also impact other parts of the food web as well as marine communities indirectly. Ultimately, the interaction of effects even has consequences for important ecosystem services such as the uptake and storage of carbon dioxide, food provision from fisheries or the recreational and cultural values of the ocean.

BIOACID: Biological Impacts of Ocean Acidification

Between 2009 and 2017, the German research network BIOACID has investigated the effects of ocean acidification on marine life and its consequences for society and economy.
More than 250 members of 20 German research institutes participated in the project coordinated by GEOMAR Helmholtz Centre for Ocean Research Kiel and Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research. The German Ministry of Education and Research supported the project with a total of 22 million Euros.

For further information please visit the BIOACID website www.oceanacidification.de.



For the process of ocean acidification, two chemical reactions are particularly important: When carbon dioxide dissolves in seawater, carbonic acid is formed. Hydrogen ions and bicarbonate are released. Part of the hydrogen ions reacts with carbonate to produce bicarbonate.
Calcifying organisms such as mussels, corals or certain plankton species use carbonate to build their shells and skeletons. The more carbonate is lost due to the chemical reactions, the more difficult calcification becomes.

Key Results from Ocean Acidification Research

> Many organisms are able to withstand ocean acidification, but may lose this ability if also exposed to other stressors such as warming, excess nutrients, loss of oxygen, reduced salinity or pollution.

> A reduction of regional stress such as nutrient runoff or the loss of oxygen can mitigate the impact of global stressors like ocean acidification and warming.

> In a natural community, the impact of stressors on a species can be amplified or diminished by associated shifts in biotic interactions such as competition, predation or parasitism.

> Even small alterations at the base of the food web can have knock-on effects for higher trophic levels.

> Marine life is able to adapt to ocean change through evolution and can partly compensate for negative effects. However, since ocean acidification happens extremely fast compared to natural processes, only organisms with short generation times, such as microorganisms, are able to keep up.

> Ocean acidification reduces the ocean's ability to store carbon.

> Changes in the ocean carbonate system impact the acid-base balance in marine organisms. This can negatively affect key processes such as calcification.

> Climate change alters the availability of prey for fish and as a consequence may affect their growth and reproduction.

> Ocean acidification and warming reduce the survival rates of early life stages of some fish species. This will likely reduce recruitment of fish stocks and ultimately fisheries yields.

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