How will ocean acidification impact marine life?

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Coral reefs, such as Australia's Great Barrier Reef pictured here, are a key calcifying species threatened by ocean acidification.

Many marine organisms—such as coral, clams, mussels, sea urchins, barnacles, and certain microscopic plankton—rely on equilibrated chemical conditions and pH levels in the ocean to build their calcium-based shells and other structures. A new analysis published in the journal *Environmental Science and Technology* provides a holistic analysis of

how species will be affected worldwide under different climate scenarios.

"Calcifying species are indispensable for ecosystems worldwide: they provide nursery habitats for fish, food for marine predators, and natural defenses for storms and erosion. These species are also particularly vulnerable to ocean acidification triggered by increased fossil fuel emissions," says IIASA researcher Ligia Azevedo, who led the study.

Just as carbonated soda water is more acidic than flat tap water, higher levels of carbon dioxide (CO_2) in the ocean cause the water to become more acidic. And high acidity makes it more difficult for calcifying species to make their calcium structures such as shells, reefs, and exoskeletons.

"Previous studies have shown that marine species were being negatively affected by decreasing ocean pH levels. But until now most studies looked at individual species. This study is one of the first to analyze the impact on the whole community of calcifying species, while also looking at both pH levels and CO_2 partial pressure," says Azevedo.

The study examines the impact of increased ocean acidity on species growth, reproduction, and survival. It used two climate change scenarios from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5): In the low emissions scenario, ocean pH is projected to decrease from 8.1 to 7.95, while in the high emissions scenario, median ocean pH is expected to decrease to 7.80. (Lower pH indicates higher acidity).

The analysis finds that under the high emissions scenario, between 21-32% of calcifying species would be significantly affected, based on a threshold of 10% of a species population being affected. In the low emissions scenario, only 7-12% of species would be affected.

Azevedo notes that while the study is an important new milestone for ocean acidification research, it does not show what level of impact which species population can handle, that is, how much acidification is too much.

"It's hard to say what the level of impact would mean for different organisms - a 10% rate could be no problem for some species, but for other more sensitive species it could mean one step closer to local extinction," explains Azevedo.

The study also emphasizes that much uncertainty remains about the level of acidification that would lead to major impacts on calcifying species - in part because of varying experimental results.

The researchers say that the analysis is an important step forward to provide policymakers a better understanding of the big picture of climate impacts on the ocean. Azevedo says, "The main benefit of this study is to provide a new research framework that policymakers could use for climate policy planning, life cycle impact assessment, and environmental risk assessment."

More information: Azevedo LB, Schryver AD, Hendriks AJ, and Huijbregts MAJ. 2015. Calcifying Species Sensitivity Distributions For Ocean Acidification. *Environmental Science and Technology*. DOI: 10.1021/es505485m (Open Access) pubs.acs.org/doi/full/10.1021/es505485m

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