

TITLE: Is Ocean Acidification an Open-Ocean Syndrome? Understanding Anthropogenic Impacts on Seawater pH

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ABSTRACT:

Ocean acidification due to anthropogenic CO₂ emissions is a dominant driver of long-term changes in pH in the open ocean, raising concern for the future of calcifying organisms, many of which are present in coastal habitats. However, changes in pH in coastal ecosystems result from a multitude of drivers, including impacts from watershed processes, nutrient inputs, and changes in ecosystem structure and metabolism. Interaction between ocean acidification due to anthropogenic CO₂ emissions and the dynamic regional to local drivers of coastal ecosystems have resulted in complex regulation of pH in coastal waters. Changes in the watershed can, for example, lead to changes in alkalinity and CO₂ fluxes that, together with metabolic processes and oceanic dynamics, yield high-magnitude decadal changes of up to 0.5 units in coastal pH. Metabolism results in strong diel to seasonal fluctuations in pH, with characteristic ranges of 0.3 pH units, with metabolically intense habitats exceeding this range on a daily basis. The intense variability and multiple, complex controls on pH implies that the concept of ocean acidification due to anthropogenic CO₂ emissions cannot be transposed to coastal ecosystems directly. Furthermore, in coastal ecosystems, the detection of trends towards acidification is not trivial and the attribution of these changes to anthropogenic CO₂ emissions is even more problematic. Coastal ecosystems may show acidification or basification, depending on the balance between the invasion of coastal waters by anthropogenic CO₂, watershed export of alkalinity, organic matter and CO₂, and changes in the balance between primary production, respiration and calcification rates in response to changes in nutrient inputs and losses of ecosystem components. Hence, we contend that ocean acidification from anthropogenic CO₂ is largely an open-ocean syndrome and that a concept of anthropogenic impacts on marine pH, which is applicable across the entire ocean, from coastal to open-ocean environments, provides a superior framework to consider the multiple components of the anthropogenic perturbation of marine pH trajectories. The concept of anthropogenic impacts on seawater pH acknowledges that a regional focus is necessary to predict future trajectories in the pH of coastal waters and points at opportunities to manage these trajectories locally to conserve coastal organisms vulnerable to ocean acidification.

SOURCE: Estuaries and coasts

PDF URL: <https://link.springer.com/content/pdf/10.1007/s12237-013-9594-3.pdf>

CITED BY COUNT: 567

PUBLICATION YEAR: 2013

TYPE: article

CONCEPTS: ['Ocean acidification', 'Environmental science', 'Ecosystem', 'Alkalinity', 'Marine ecosystem', 'Watershed', 'Oceanography', 'Seawater', 'Ecology', 'Chemistry', 'Biology', 'Geology', 'Organic chemistry', 'Machine learning', 'Computer science']