Ocean's deep-water may be corroding Byron Bay's coastal ecosystems

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Cold ocean waters, the sort that gives relief to beachgoers in the heat of summer, may in fact be corroding coastal ecosystems according to new research from Southern Cross University.

This is because upwelling events—when cold water is forced up from the deep ocean floor—along the East Australian coast (caused by the East Australian Current (EAC)) are accompanied by increasing levels of carbon dioxide which leads to ocean acidification.

On the other side of the Pacific Ocean, in the Californian and Peruvian systems, such upwelling events are accompanied by significant drops in seawater oxygen saturation and pH. Lower pH levels lead to conditions where upwelling waters become corrosive to the mineral aragonite, a vital building block of a number of marine organisms, including corals, snails, mussels and oysters. So, what's the situation back home in Australia?

Southern Cross University's Centre for Coastal Biogeochemistry research team, led by oceanographer Dr. Kai Schulz, based themselves in the Cape Byron Marine Park off Byron Bay for four months to investigate the chemical properties of deep-water being upwelled off the Australian mainland's most easterly point.

The results reveal that upwelling and increasing levels of anthropogenic carbon dioxide act in concert to degrade habitat suitability, especially for aragonite producers. The paper is published in the journal *Frontiers in Marine Science*.

"With temperatures dropping by up to 5 degrees Celsius, oxygen by 34%, pH by 0.12 and aragonite saturation state (Ωarag) by 0.9 units, these events are highly significant," Dr. Schulz said.

Extrapolating present day data to pre-Industrial times, the team found that the combination of ongoing ocean acidification and upwelling has already led to the crossing of a number of biological and geochemical Ω_{arag} thresholds, such as the dissolution of aragonite in reef sediments.

Once calcium carbonate dissolution exceeds calcium carbonate production in reefs they are doomed to disappear.

"This is due to increasing levels of anthropogenic carbon dioxide which leads to ocean acidification," said co-author Professor Bradley Eyre.

In total, the team identified 32 major deep-water upwelling events. With an average of one event every four days, this is more than the team had anticipated.

"These water masses originate from 200 to 250 meters off the Central East Australian shelf," said Associate Lecturer and Diving Officer Simon Harley.

When comparing deep-water signatures along the East Australian shelf, the researchers found that the situation further north in the Great Barrier Reef might be even more pronounced. This is because today shelf-associated waters carry already a stronger deep-water signal than at the current study location at Cape Byron.

With the Great Barrier Reef estimated to currently contribute more than $6 billion annually to the Australian economy, deep-water upwelling and its impact in a changing climate would come at a considerable financial cost.

"Looking into the future, the intensity and impact of these events critically depends on our ability to curb anthropogenic CO_2 emissions," said Dr. Schulz.

More information: Kai G. Schulz et al. Upwelling Amplifies Ocean

Acidification on the East Australian Shelf: Implications for Marine Ecosystems, *Frontiers in Marine Science* (2019). DOI: 10.3389/fmars.2019.00636

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