Coastal factsheet series

OCEAN ACIDIFICATION

07

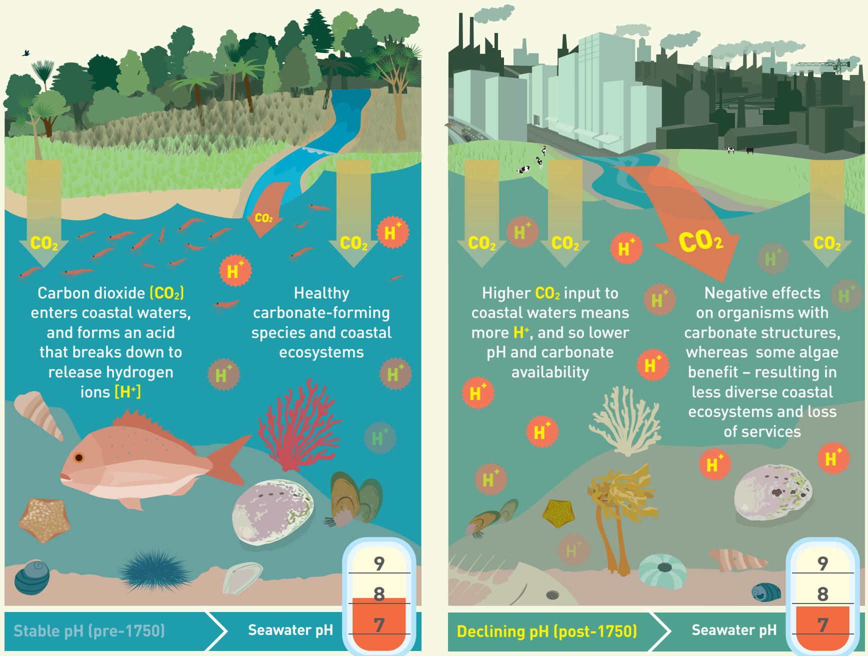
WHAT IS OCEAN ACIDIFICATION?

Between one quarter and one third of all the carbon dioxide (CO_2) we produce ends up in the ocean. While this slows the rate of climate change, it also has negative impacts on the chemistry of the ocean as it causes the water to acidify.

Acidity is measured by pH. Acidic substances (such as vinegar) have a pH less than 7, while alkaline substances (such as bleach) have a pH greater than 7. The ocean is alkaline (pH ~8.1), but it has been acidifying over the last 250 years due to increased carbon dioxide uptake.

By the end of this century, the ocean will have experienced the largest and fastest rate of change in pH in the last 25 million years.

Ocean acidification has a number of effects on the chemistry of seawater. One of the most significant is a reduction in the availability of dissolved carbonate which is essential for the survival of many organisms that build shells.



Source: NIWA. Graphic: Arie Ketel

The chemistry of acidification – how increasing carbon dioxide (CO2) leads to ocean acidification

IS IT SIGNIFICANT IN COASTAL WATERS?

In addition to atmospheric carbon dioxide, the pH of coastal waters is affected by other sources associated with human activities. Organic matter and nutrients from the land are carried by rivers into coastal waters, causing bacteria to produce more carbon dioxide and lowering pH. This results in lower pH than in the open ocean, particularly in enclosed coastal waters such as the Firth of Thames.

As coastal waters also experience warmer temperatures and lower dissolved oxygen at particular times of the year, the continued decline in pH may have serious deleterious effects on coastal ecosystems.

HOW COULD THIS AFFECT COASTAL ECOSYSTEMS?

An increase in dissolved carbon dioxide may positively impact marine algae, such as phytoplankton and seaweeds, which may benefit from coastal acidification. However, this may also result in changes in the composition of algal communities and affect the food supply and habitat for other organisms.

The decline in dissolved carbonate availability potentially threatens a variety of organisms that form carbonate shells or skeletons, especially during their early life stages. Ocean acidification may negatively impact species such as paua, oysters, cockles, mussels and kina.

It has also been shown that the behaviour of fish is altered under lower pH, making them more vulnerable to predators. Overall, at lower pH, many species have to invest more energy in regulating their internal chemistry, which leaves less energy for growth and reproduction. Although some are more resistant to low pH, others will find it difficult to adapt to the rapid rate of acidification.

ARE NEW ZEALAND WATERS ACIDIFYING?

Measurements in subantarctic surface water off Otago over the last 15 years have confirmed that the ocean around New Zealand is acidifying. The challenge now is to determine how significant this is in coastal waters.

The New Zealand Ocean Acidification - Observing Network (NZOA-ON) is monitoring pH at 14 different coastal locations, including pristine and impacted sites around the country. Water samples are collected, and sensors measure pH continuously. This information will show how pH varies, both at and between sites, and ultimately the rate at which New Zealand coastal waters are acidifying.

WHAT ARE THE ECOSYSTEM IMPACTS AROUND NEW ZEALAND?

Research from around New Zealand indicates a range of potential impacts on different species from coasts to the deep sea. The decline in carbonate may lead to loss of cold water corals in deep waters, which support important ecosystems in regions such as the Chatham Rise.

Whereas some seaweeds may benefit from low pH, encrusting coralline algae (which use carbonate) may decline and this could remove habitat for shellfish spat.

Shellfish larvae are often malformed at low pH, which reduces their chance of reaching the adult stage. Low pH also causes a reduction in growth and some shell dissolution in juvenile paua, whereas some plankton and shellfish are less affected by low pH.

Overall, acidification is likely to cause a decrease in biodiversity, and may affect the food supply and recreational benefits we gain from our coastal waters.

WHAT IS WAIKATO REGIONAL COUNCIL DOING?

Waikato Regional Council recognises that coastal waters in the Waikato region are slowly acidifying which will have increasing impacts over time. We work on better understanding these impacts and how we can mitigate them through resource management actions.

Waikato Regional Council supports a research project called CARIM (Coastal Acidification: Rate, Impacts & Management), led by NIWA, that aims to establish the rate and impacts of acidification, and inform measures to manage coastal ecosystems, including in the Firth of Thames.

CARIM will also look at the sensitivity of three iconic New Zealand species – green-lipped mussel, paua and snapper – to low pH across their life cycle to determine how low pH might affect them. New research comparing the resilience of paua and green-lipped mussel from different locations to low pH may also benefit the aquaculture industry.

Waikato Regional Council also supports a related project investigating practical options for mitigating acidification, such as the return of waste mussel shells to increase carbonate levels around shellfish farms. However this may only be effective at local scales. In order to prevent further acidification of the ocean, reductions in carbon dioxide emissions on a global scale are required.

MORE INFORMATION

Contact

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Web

www.waikatoregion.govt.nz

CARIM

www.carim.nz/

NZOA-ON

www.niwa.co.nz/coasts-and-oceans/research-projects/new-zealand-ocean-acidification-observing-network-nzoa-on

NZOAC

www.nzoac.nz/#new-zealand-ocean-acidification-community

Firth of Thames, Coromandel

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