

## Ocean acidification in the western tropical Pacific

The changing seawater chemistry of the Pacific in response to increasing carbon dioxide in the atmosphere entering the ocean poses a significant threat to long-term viability of coral reefs and associated marine ecosystems, and to coastal communities that rely on them for their livelihood and wellbeing.

### What is ocean acidification?

**Ocean acidification** is a change in ocean chemistry that occurs when atmospheric carbon dioxide is taken up by the ocean, thereby increasing pH. Carbon dioxide is a weak acid, so when it enters the ocean it reacts with seawater, increasing acidity. Oceans absorb about 25% of the carbon dioxide that is emitted into the atmosphere annually. As more carbon dioxide enters the atmosphere, more carbon dioxide is dissolved in the oceans. This process plays a key role in reducing the rate of global warming and therefore climate change, but it also changes the chemistry of the oceans. Carbonate (ion) is one form in which carbon is stored in the ocean, and is a critical requirement for coral growth. Increased acidity will result in less carbonate (ion) availability in the ocean to support coral growth. This poses a significant threat to the diversity, productivity and overall health of vulnerable, high-value aquatic ecosystems, including coral reef structures and associated fisheries, aquatic resources and marine biodiversity.



**Proximity of fringing coral reef to concentration of local communities and critical infrastructure in Tuvalu (left), and coral showing signs of bleaching (above)**

### What are the impacts on the environment?

- Calcium carbonate (in a form called aragonite) is used by corals to form hard reef structures. Coral growth is strongly linked with the aragonite saturation state of seawater. Projections of aragonite saturation state under high and medium carbon dioxide emission scenarios suggest it will be harder for corals and other marine organisms to form their hard skeletons and shells in the future.
- Global climate projections suggest that if atmospheric carbon dioxide emissions continue at their current rate, by 2050 coral reefs in the western tropical Pacific may not only stop growing but start to get smaller, as they dissolve faster than they are built.
- As corals become stressed they become more susceptible to disease and coral bleaching (see box), and more vulnerable to other environmental pressures such as warming temperatures and storm-related wave damage. Increasing ocean acidification places additional stress on corals in an already warming ocean, so coral bleaching may occur at lower temperatures.
- Globally about 50% of the ocean's biodiversity lives in and around coral reefs, from plankton to large aquatic plants, fish and invertebrates, including molluscs and crustaceans. Changes in reef health will have flow-on effects for these species.
- Animals such as oysters, clams, lobsters, crabs and starfish use calcium carbonate to make their hard shells. The reduction of carbonate in the ocean also means that it will be harder for these creatures to make their shells.
- As ocean acidification continues, altered nutrient and energy cycles will impact directly on aquatic plants and animals, further reducing the function, productivity and resilience of reef ecosystems.



**Diverse and abundant fish and coral reef communities in Tuvalu**

### What is coral bleaching?

Corals consist of coral polyps; small animals that have a symbiotic relationship with the tiny plants (zooxanthellae) living inside them. Coral bleaching occurs when the coral polyps become stressed and eject the plants. Without this plant, the coral appears white or bleached and can ultimately die. Without corals providing foundational structure, severe and widespread bleaching events can result in the collapse of entire reef ecosystems.

## How might ocean acidification impact Pacific island communities?

- Many coral reefs and associated aquatic ecosystems in the western tropical Pacific are high-value marine protected areas. A reduction in their health could have serious impacts on public amenity, tourism and economic development
- About 70% of protein in the diet of Pacific islanders is derived from near-shore pelagic and inshore reef and lagoon fisheries. Any decline in productivity or biodiversity of these fisheries may have serious impacts on food security, which in turn will impact the economic and social wellbeing of coastal communities. These threats also extend to related commercial activities such as tourism and aquaculture; the latter including farming of black pearls, giant clams, trochus, shrimp, sea cucumber and milkfish.
- Coral reefs protect coastal resources and infrastructure by buffering coastlines from wave damage and tropical storms. As reef structures erode faster than they can regenerate they will no longer be able to offer the same level of protection to the coastline.

## Building resilience for a more sustainable future

Ocean acidification is only one of many challenges that climate variability and change

present to local communities in the western tropical Pacific. Maintaining the ecological health, functional integrity and resilience of reef ecosystems is essential for the long-term wellbeing of local communities.

The timely provision of reliable scientific understanding and evidence to inform decision-making will enable more effective and efficient management and planning: an essential requirement for securing sustainable development in the region.

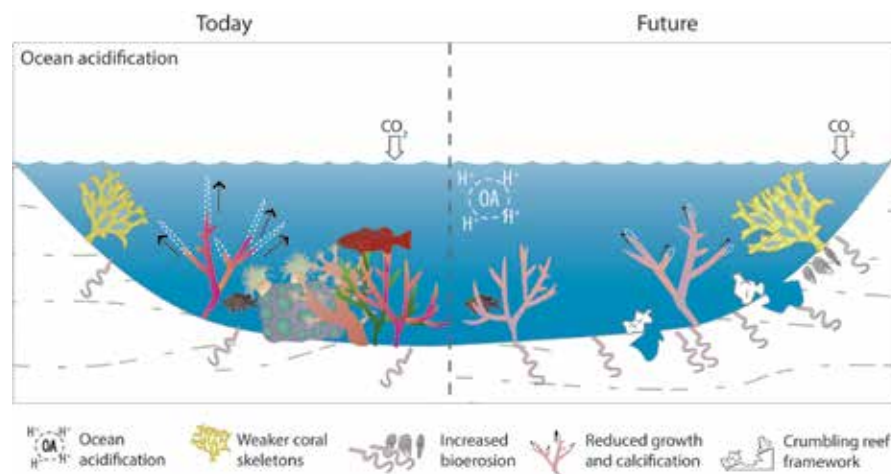
## CASE STUDY

### Ocean acidification in Papua New Guinea

Naturally occurring seeps of carbon dioxide in Milne Bay in Papua New Guinea provide insights into how ocean acidification will impact coral reefs and the aquatic ecosystems they support. Within these seeps, corals experience ocean acidification levels similar to that projected by the end of this century. These areas are characterised by a significant decrease in coral diversity and health, less habitat for the species that live in and around the reefs, and correspondingly large shifts in marine ecosystem structure. While some species grow better under higher levels of ocean acidification, overall the effects on marine ecosystems are negative and the high conservation values of these key environments are greatly reduced.



Corals in Milne Bay, Papua New Guinea, under present day conditions showing healthy coral communities (top) and nearby corals in a natural carbon dioxide seep (bottom). (Photos: K.Fabricus)



### The potential impacts of projected ocean acidification on coral reef ecosystems.

(Figure: Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change. Source: Hoegh-Guldberg *et al.* in Bell, Johnson and Hobday (eds), 2011/SPC, New Caledonia.)

### Other fact sheets in the series include:

- Climate extremes in the western tropical Pacific
- Large-scale climate features in the western tropical Pacific
- Climate variability and climate change in the western tropical Pacific
- Sea-level rise in the western tropical Pacific



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