Marine reserves saved coral reefs from Queensland floods

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Andrew Olds
Research Fellow, Griffith University

David Rissik
Deputy Director (General Manager), National Climate Change Adaptation Research Facility, Griffith University

Kylie Pitt
Senior Lecturer, Griffith School of Environment, Australia Rivers Institute, Griffith University, Griffith University

Paul Maxwell
Marine Ecologist, Griffith University

Rod Connolly
Professor in Marine Science, Griffith University

Russ Babcock
Senior Principal Research Scientist, CSIRO

Marine reserves are a hot topic in Australia, with federal and state governments debating whether to allow recreational fishers to take fish from within their boundaries. But new research demonstrates that reserves can have a real benefit for marine ecosystems — by protecting coral reefs from floods.

Floodwater plumes, like this one in Moreton Bay, do less damage to reefs that are in marine reserves.

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We enjoy fishing; but we also appreciate that marine reserves have many positives. Yes, they restrict fishing in certain areas, but they have been shown to increase the numbers of catchable fish outside reserves.

Our study shows that reserves can also improve the resilience of the habitats that fish rely on. Without them, there would be fewer fish for everyone.

Reefs better off in reserves

Our research, published today in *Global Change Biology*, investigates how coral reefs respond to disturbance. In 2011 Queensland was struck by catastrophic flooding, which resulted in three-quarters of Queensland being declared a flood disaster zone – an area as big as France, Germany and Italy combined.

While the disaster on land is well documented, we wondered what happened out to sea. We looked at coral reefs in Moreton Bay near the mouth of the Brisbane River, which drains into the bay.

Ten coral reefs were surveyed by a team of divers before the flood, immediately after the flood had passed, and again one year later. Four reefs were inside marine reserves and six reefs were open to fishing.

We found that reefs in marine reserves, where no fishing is allowed, were better able to cope with flood impacts compared to reefs where fishing is allowed.

How floods affect reefs

The shift in catchment land-use from predominantly forested to agricultural and urban means that floods dump lots of sediment into coastal waters. This smothers inshore coral reefs and fuels the rapid growth of algae. Algae compete with coral for space and can overgrow and harm coral when nutrients are in plentiful supply (as is the case after floods).

On healthy coral reefs the growth of algae is kept under control by herbivorous fish (i.e. fish that eat plants) such as rabbitfish, parrotfish and surgeonfish.

The settlement of baby corals is also important and helps to maintain coral dominance. Both grazing by herbivorous fish and coral settlement are vital to sustaining the reef’s health.

Our Moreton Bay research shows that coral reefs inside marine reserves support more herbivorous fish, which are harvested by spear and net fishers outside reserves. Reserve reefs also experience greater herbivory and coral settlement than similar reefs that are open to fishing. This means that after the 2011 floods, algae was rapidly removed from reefs in marine reserves, but wasn’t controlled on similar fished reefs.
Do reserves protect other ecosystems from disturbance?

So we know reserves can help protect reefs from floods — could the same apply to other ecosystems?

To withstand disturbances (such as floods), reserves need to promote processes that enable ecosystems to function. In the case of reefs in Moreton Bay, this is herbivory and coral settlement.

Other studies have shown that reserves can have benefits for ecological processes (like herbivory and predation) in kelp forests, seagrass meadows and forests. But we don’t yet know if this will translate into greater capacity to recover from disturbances.

Ultimately, protecting marine ecosystems from disturbance depends on how reserves are designed, why they’re created, and how they are managed. Recent research led by the University of Tasmania showed that by-and-large, marine reserves aren’t doing the job of protecting marine life, but well-designed and managed reserves can have eight times the number of large fish.

Reserves could lead in fight against climate change

The main purpose of conservation strategies such as marine reserves is to maintain and enhance biodiversity. But there is now also great interest in using reserves to improve the resilience of degraded ecosystems.

Our research adds weight to the idea that reserves can promote ecosystem health, at least in coastal waters. Our study also suggests marine reserves can play a key role in protecting coastal ecosystems from future disturbance, and particularly some of the effects of climate change. The capacity of marine reserves to protect coral reefs from floods will likely be important in the future, given that the frequency and severity of extreme weather events are projected to increase.

Our findings provide strong evidence that well designed and managed marine reserves can deliver sound benefits for ecosystems – many of which take time to become apparent.

The ecosystem benefits of marine reserves stem from the key roles that fish play in coastal habitats. For example, herbivorous fish on coral reefs remove algae and promote coral health, but can also be harvested heavily by spear and net fishers.
Re-opening marine reserves to fishing can, therefore, have unintended consequences that extend beyond direct effects on fish and fishers, and may impact on the functioning of coastal ecosystems.

*Dr Andrew Olds conducted this study at Griffith University and has since moved to the University of the Sunshine Coast.*