

A world without coral reefs

OUR EARTH II

Coral reefs are history. It is time to accept this and start looking into what to do about it.

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CANBERRA, AUSTRALIA It's past time to tell the truth about the state of the world's coral reefs, the nurseries of tropical coastal fish stocks. They have become zombie ecosystems, neither dead nor truly alive in any functional sense, and on a trajectory to collapse within a human generation. There will be remnants here and there, but the global coral reef ecosystem — with its storehouse of biodiversity and fisheries supporting millions of the world's poor — will cease to be.

Overfishing, ocean acidification and pollution are pushing coral reefs into oblivion. Each of those forces alone is fully capable of causing the global collapse of coral reefs; together, they assure it. The scientific evidence for this is compelling and unequivocal, but there seems to be a collective reluctance to accept the logical conclusion — that there is no hope of saving the global coral reef ecosystem.

What we hear instead is an airbrushed view of the crisis — a view endorsed by coral reef scientists, amplified by environmentalists and accepted by governments. Coral reefs, like rain forests, are a symbol of biodiversity. And, like rain forests, they are portrayed as existentially threatened — but salvageable. The message is: "There is yet hope."

Indeed, this view is echoed in the "consensus statement" of the just-concluded International Coral Reef Symposium, which called "on all governments to ensure the future of coral reefs." It was signed by more than 2,000

scientists, officials and conservationists.

This is less a conspiracy than a sort of institutional inertia. Governments don't want to be blamed for disasters on their watch, conservationists apparently value hope over truth, and scientists often don't see the reefs for the corals.

But by persisting in the false belief that coral reefs have a future, we grossly misallocate the funds needed to cope with the fallout from their collapse. Money isn't spent to study what to do after the reefs are gone — on what sort of ecosystems will replace coral reefs and what opportunities there will be to nudge these into providing people with food and other useful ecosystem products and services.

Nor is money spent to preserve some of the genetic resources of coral reefs by transferring them into systems that are not coral reefs. And money isn't spent to make the economic structural adjustment that communities and industries that depend on coral reefs urgently need. We have focused too much on the state of the reefs rather than the rate of the processes killing them.

Overfishing, ocean acidification and pollution have two features in common. First, they are accelerating. They are growing broadly in line with global economic growth, so they can double in size every couple of decades. Second, they have extreme inertia — there is no real prospect of changing their trajectories in less than 20 to 50 years. In short, these forces are unstoppable and irreversible. And it is these two features — acceleration and inertia — that have blindsided us.

Overfishing can bring down reefs because fish are one of the key functional groups that hold reefs together. De-

tailed forensic studies of the global fish catch by Daniel Pauly's lab at the University of British Columbia confirm that global fishing pressure is still accelerating even as the global fish catch is declining. Overfishing is already damaging reefs worldwide, and it is set to double and double again over the next few decades.

Ocean acidification can also bring down reefs because it affects the corals themselves. Corals can make their calcareous skeletons only within a special range of temperature and acidity of the surrounding seawater. But the oceans are acidifying as they absorb increasing amounts of carbon dioxide from the atmosphere. Research led by Ove Hoegh-Guldberg of the University of Queensland shows that corals will be pushed outside their temperature-acidity envelope in the next 20 to 30 years, absent effective international action on emissions.

We have less of a handle on pollution. We do know that nutrients, particularly nitrogenous ones, are increasing not only in coastal waters but also in the open ocean. This change is accelerating. And we know that coral reefs just can't survive in nutrient-rich waters. These conditions only encourage the microbes and jellyfish that will replace coral reefs in coastal waters. We can say, though, with somewhat less certainty than for overfishing or ocean acidification that unstoppable pollution will force reefs beyond their survival

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envelope by mid-century.

This is not a story that gives me any pleasure to tell. But it needs to be told urgently and widely because it will be disaster for the hundreds of millions of people in poor, tropical countries like Indonesia and the Philippines who depend on coral reefs for food. It will also threaten the tourism industry of rich countries with coral reefs, like the United States, Australia and Japan. Countries like Mexico and Thailand will have both their food security and tourism industries badly damaged. And, at most an afterthought, it will be a tragedy for global conservation as hot spots of biodiversity are destroyed.

What we will be left with is an algal-dominated hard ocean bottom, as the remains of the limestone reefs slowly break up, with lots of microbial life soaking up the sun's energy by photosynthesis, few fish but lots of jellyfish grazing on the microbes. It will be slimy and look a lot like the ecosystems of the Precambrian era, which ended more than 500 million years ago and well before fish evolved.

Coral reefs will be the first, but certainly not the last, major ecosystem to succumb to the Anthropocene — the new geological epoch now emerging. That is why we need an enormous reallocation of research, government and environmental effort to understand what has happened so we can respond the next time we face a disaster of this magnitude. It will be no bad thing to learn how to do such ecological engineering now.

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