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Coral reefs 'will be gone by end of the century'

They will be the first entire ecosystem to be destroyed by human activity, says top UN scientist

By Andrew Marszal

Coral reefs are on course to become the first ecosystem that human activity will eliminate entirely from the Earth, a leading United Nations scientist claims. He says this event will occur before the end of the present century, which means that there are children already born who will live to see a world without coral.

The claim is made in a book published tomorrow, which says coral reef ecosystems are very likely to disappear this century in what would be "a new first for mankind – the 'extinction' of an entire ecosystem". Its author, Professor Peter Sale, studied the Great Barrier Reef for 20 years at the University of Sydney. He currently leads a team at the United Nations University Institute for Water, Environment and Health.

The predicted decline is mainly down to climate change and ocean acidification, though local activities such as overfishing, pollution and coastal development have also harmed the reefs. The book, Our Dying Planet, published by University of California Press, contains further alarming predictions, such as the prospect that "we risk having no reefs that resemble those of today in as little as 30 or 40 more years".

"We're creating a situation where the organisms that make coral reefs are becoming so compromised by what we're doing that many of them are going to be extinct, and the others are going to be very, very rare," Professor Sale says. "Because of that, they aren't going to be able to do the construction which leads to the phenomenon we call a reef. We've wiped out a lot of species over the years. This will be the first time we've actually eliminated an entire ecosystem."

Coral reefs are important for the immense biodiversity of their ecosystems. They contain a quarter of all marine species, despite covering only 0.1 per cent of the world's oceans by area, and are more diverse even than the rainforests in terms of diversity per acre, or types of different phyla present.

Recent research into coral reefs' highly diverse and unique chemical composition has found many compounds useful to the medical industry, which could be lost if present trends persist. New means of tackling cancer developed from reef ecosystems have been announced in the past few months, including a radical new treatment for leukaemia derived from a reef-dwelling sponge. Another possible application of compounds found in coral as a powerful sunblock has also been mooted.

And coral reefs are of considerable economic value to humans, both as abundant fishing resources and – often more lucratively – as tourist destinations. About 850 million people live within 100km of a reef, of which some 275 million are likely to depend on the reef ecosystems for nutrition or livelihood. Fringing reefs can also help to protect low-lying islands and coastal regions from extreme weather, absorbing waves before they reach vulnerable populations.

Carbon emissions generated by human activity, especially our heavy use of fossils fuels, are the biggest cause of the anticipated rapid decline, impacting on coral reefs in two main ways. Climate change increases ocean surface temperatures, which have already risen by 0.67C in the past century. This puts corals under enormous stress and leads to coral bleaching, where the photosynthesising algae on which the reef-building creatures depend for energy disappear. Deprived of these for even a few weeks, the corals die.

On top of this comes ocean acidification. Roughly one-third of the extra carbon dioxide we put into the atmosphere is absorbed through the ocean surface, acidifying shallower waters. A more recently recognised problem in tropical reef systems, the imbalance created

makes it harder for reef organisms to retrieve the minerals needed to build their carbonaceous skeletons. "If they can't build their skeletons – or they have to put a lot more energy into building them relative to all the other things they need to do, like reproduce – it has a detrimental effect on the coral reefs," says Paul Johnston of the University of Exeter, and founder of the UK's Greenpeace Research Laboratories.

An important caveat to the book's predictions is that the corals themselves – the tiny organisms largely responsible for creating reefs – may be lucky enough to survive the destruction, if past mass extinction episodes are anything to go by. "Although corals are ancient animals and have been around for hundreds of millions of years, there have been periods of reefs, and periods where there are no reefs," explains Mark Spalding, of the US-based environmental group Nature Conservancy, and the University of Cambridge. "When climatic conditions are right they build these fantastic structures, but when they're not they wait in the wings, in little refuges, as a rather obscure invertebrate."

The gaps between periods in which reefs are present have been long even in geological terms, described in the book as "multimillion-year pauses". And reef disappearance has tended to precede wider mass extinction events, offering an ominous "canary in the environmental coal mine" for the present day, according to the author. "People have been talking about current biodiversity loss as the Holocene mass extinction, meaning that the losses of species that are occurring now are in every way equivalent to the mass extinctions of the past," Professor Sale says. "I think there is every possibility that is what we are seeing."

About 20 per cent of global coral reefs have already been lost in the past few decades. Mass bleaching events leading to widespread coral death are a relatively recent phenomenon; though scientists have been studying coral reefs in earnest since the 1950s, mass bleaching was first observed only in 1983.

Dr Spalding, who witnessed the catastrophic 1998 mass bleaching in the Indian Ocean first-hand, says: "It was a shocking wake-up call for the world of science, and a shocking wake-up for me to be actually there as we watched literally 80 to 90 per cent of all the corals die on the reefs of the Seychelles and other islands in a few weeks." That single event destroyed 16 per cent of the world's coral.

But according to the book's author: "The 1998 bleaching was spectacular because it was so extensive and so conspicuous. But there have been mass bleachings that have been global since then: 2005 was bad; 2010 was bad. The visual appearance is not nearly as severe as it was in 1998, simply because there is less coral around."

These dramatic episodes coincide with unusual weather patterns such as El Niño, but are increasing in severity and frequency due to climate change. As such, tackling global warming is the most urgent solution advocated by the book. "If we can keep CO2 concentrations below 450 parts per million we would be able to save something resembling coral reefs," Professor Sale says. "They wouldn't be the coral reefs of the 1950s or 1960s, but they would be recognisably coral reefs, and they would function as reefs." The current atmospheric carbon dioxide concentration is about 390 parts per million, but few experts believe it will remain below 500 for long.

There are signs that local conservation efforts can make a difference. Alex Rogers, professor of conservation biology at Oxford University, says: "We know for certain that corals subject to low levels of stress are much more able to recover. So if you take away pressures like overfishing of coral reefs and pollution, this has profound effects on recovery. But what we're really doing is buying time for many of these ecosystems. If climate change continues at its current rate, they will be done for eventually."

Though not all scientists agree with the precise timescales set out by the book, the crisis is clear. "When you're talking about the destruction of an entire ecosystem within one human generation, there might be some small differences in the details – it is a dramatic image and a dramatic statement," Professor Rogers says. "But the overall message we agree with. People are not taking on board the sheer speed of the changes we're seeing."