Individual ecosystems survived the largest known mass extinction event

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The end of the Permian geologic time period, 252 million years ago, was marked by huge volcanic eruptions that resulted in global warming and a change in climate so severe it caused the extinction of nearly all animals on the planet.

But a new study, published in Nature Geoscience, shows for the first time how the extinction of such vast numbers barely affected the ecology of marine environments.

'Biodiversity is composed of two things, its richness – the number of species – and the diversity of its ecosystems. This isn't about the numbers of species that went extinct,' explains lead researcher Professor Richard Twitchett of Plymouth University.

'When we looked at the ecology we saw that, of the groups that drive an ecosystem's functions, none were completely eliminated; the survivors fulfilled all of the roles needed in the ecosystem,' Twitchett continues. 'There was always one animal somewhere on the planet doing what it needed to make the ecosystem function.'

Twitchett's research may help us to understand how marine ecosystems could be affected by present-day climate change, and gives conservationists a deeper understanding of how to protect entire ecosystems, not just individual species.

'The end of the Permian was a time of global warming, and also saw the biggest extinction we know of from the fossil record, so perhaps the fact that no single ecological group was eliminated gives us a cause for optimism. It tells us that modes of life are very resistant and we would have to decimate things significantly to break them down,' says Twitchett.

The researchers used a newly available online database of the fossil record to build their own lists of genera – groups of species – that went extinct after the Permian. Once they had a list of around 1500 genera the pair studied how each individual contributed to its ecosystem by assessing how it fed where it lived and how it moved.

But crucially, unlike many other studies which rely on the fossil record, Twitchett and Foster also included species that were likely to have been around at the time, even though there is no trace of them in the rocks.

The pair then studied how the changing climate affected those ecosystems globally and regionally.

'Looking at the global picture, ecosystems were fairly unchanged,' Twitchett explains. 'But when we looked regionally, at smaller scales, we

saw there were dramatic changes. Before the extinction event the tropics had the greatest ecological diversity, but immediately after they become too hot for ecosystems to function. It was a time of global warming and you actually see the peaks in diversity move north, to more temperate latitudes.'

Coral reefs are also known to have been hard hit by the extinction event, but the team were surprised to find that they were affected even before the eruptions caused the change in climate.

'The surprising thing is that the major ecological changes on the coral reefs seem to happen millions of years before the event, not associated with any mass extinction, so there must be something going on in reef ecosystems that we don't yet fully understand ,' he says.

The team now intend to study the reefs in more detail to understand the ecology of the animals living on the reef and their predators and prey.

More information: "Functional diversity of marine ecosystems after the Late Permian mass extinction event." William J. Foster & Richard J. Twitchett. *Nature Geoscience* (2014) DOI: 10.1038/ngeo2079

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