The threatened brown mouse lemur (*Microcebus rufus*), unique to Madagascar. Photograph: Chien C Lee/PA

Biodiversity

Ecosystem collapse 'inevitable' unless wildlife losses reversed

Scientists studying the Permian-Triassic mass extinction find ecosystems can suddenly tip over

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The steady destruction of wildlife can suddenly tip over into total ecosystem collapse, scientists studying the greatest mass extinction in Earth's history have found.

Many scientists think the huge current losses of biodiversity are the start of a new mass extinction. But the new research shows total ecosystem collapse is "inevitable", if the losses are not reversed, the scientists said.

The Permian-Triassic extinction event, known as the “Great Dying” occurred 252 million years ago. It was driven by global heating resulting from huge volcanic eruptions and wiped out 95% of life on Earth.

However, species are being lost today even faster than in any of the previous five mass extinctions that have struck the planet. Wildlife is being destroyed via the razing of natural habitats for farming and mining, pollution and overhunting. Humanity relies on healthy global ecosystems for clean air and water, as well as food.

The new research examined in detail marine fossils found in China from before, during and after the Great Dying. Healthy ecosystems rely on the complex interaction of plants, predators and prey, with each group of similar species playing a unique role.

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The scientists found half the species went extinct with virtually no change in the overall functioning of the ecosystem, because some creatures still remained in each role. However, once the last species in each role began to go extinct, the ecosystem rapidly collapsed. “Ecosystems were pushed to a tipping point from which they could not recover,” said Dr Yuangeng Huang, at the China University of Geosciences and lead author of the study.

“We are currently losing species at a faster rate than in any of Earth’s past extinction events. It is probable that we are in the first phase of another, more severe mass extinction,” he said. “We cannot predict the tipping point that will send ecosystems into total collapse, but it is an inevitable outcome if we do not reverse biodiversity loss.”

The research, published in the journal Current Biology, examined fossils from south China, which was a shallow sea during the Permian-Triassic mass extinction. The team recreated the ancient marine environment using simulated

food webs to represent the ecosystem before, during, and after the extinction event.

The Great Dying was caused by volcanic eruptions that drove up carbon dioxide in the atmosphere, resulting in climate conditions similar to those being caused today by fossil fuel burning, ie global heating, ocean acidification and loss of oxygen in the seas.

In the first phase of the extinction, a sufficient number of species remained to perform essential functions, said Dr Peter Roopnarine at the California Academy of Sciences: “But when environmental disturbances like global warming or ocean acidification occurred later on, ecosystems were missing that reinforced resistance, which led to abrupt ecological collapse. This took place about 60,000 years after the initial biodiversity crash.”

Prof Michael Benton, at the University of Bristol and part of the team, said: “The fossil sites in China are perfect for this kind of study because we need abundant fossils so we can reconstruct food webs. Also, the rock sequences can be dated very precisely, so we can track step by step all through the crisis when life in the oceans was killed by heat shock, ocean acidification and loss of oxygen from the seabed.”

The researchers concluded: “A biodiversity crash may be the harbinger of a more devastating ecosystem collapse.” They said the work showed that conservation efforts today must focus not simply on species but also on all the different roles they play.

The scientists considered whether a change in environmental conditions could have caused the second phase of the extinction – the collapse – but thought it unlikely. They also said further research was required to replicate their findings around the world.