

Has the Earth's sixth mass extinction already arrived?

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Tigers are one of Earth's most critically endangered species. Extinction of the majority of such species would indicate the sixth mass extinction is in our near future. Credit: Anthony Barnosky, UC Berkeley

With the steep decline in populations of many animal species, from frogs and fish to tigers, some scientists have warned that Earth is on the brink of a mass extinction like those that occurred only five times before during the past 540 million years. Each of these 'Big Five' saw three-quarters or more of all animal species go extinct.

In a study to be published in the March 3 issue of the journal *Nature*, University of California, Berkeley, paleobiologists assess where mammals and other species stand today in terms of possible extinction, compared with the past 540 million years, and they find cause for hope

as well as alarm.

"If you look only at the critically endangered mammals - those where the risk of extinction is at least 50 percent within three of their generations - and assume that their time will run out, and they will be extinct in 1,000 years, that puts us clearly outside any range of normal, and tells us that we are moving into the mass extinction realm," said principal author Anthony D. Barnosky, UC Berkeley professor of integrative biology, a curator in the Museum of Paleontology and a research paleontologist in the Museum of Vertebrate Zoology.

"If currently threatened species - those officially classed as critically endangered, endangered and vulnerable - actually went extinct, and that rate of extinction continued, the sixth mass extinction could arrive within as little as 3 to 22 centuries," he said.

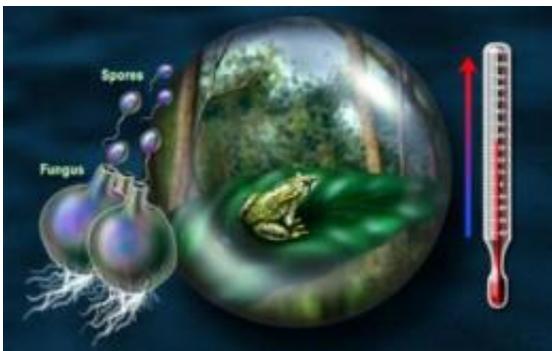
Nevertheless, Barnosky added, it's not too late to save these critically endangered mammals and other such species and stop short of the tipping point. That would require dealing with a perfect storm of threats, including habitat fragmentation, invasive species, disease and global warming,

"So far, only 1 to 2 percent of all species have gone extinct in the groups we can look at clearly, so by those numbers, it looks like we are not far down the road to extinction. We still have a lot of Earth's biota to save," Barnosky said. "It's very important to devote resources and legislation toward species conservation if we don't want to be the species whose activity caused a mass extinction."

Coauthor Charles Marshall, UC Berkeley professor of integrative biology and director of the campus's Museum of Paleontology, emphasized that the small number of recorded extinctions to date does not mean we are not in a crisis.

"Just because the magnitude is low compared to the biggest mass extinctions we've seen in a half a billion years doesn't mean to say that they aren't significant," he said. "Even though the magnitude is fairly low, present rates are higher than during most past mass extinctions."

"The modern global mass extinction is a largely unaddressed hazard of climate change and human activities," said H. Richard Lane, program director in the National Science Foundation's Division of Earth Sciences, which funded the research. "Its continued progression, as this paper shows, could result in unforeseen - and irreversible - negative consequences to the environment and to humanity."



Earth's warming climate is contributing to an infection responsible for tropical frog extinctions. Credit: Nicolle Rager Fuller, National Science Foundation

The study originated in a graduate seminar Barnosky organized in 2009 to bring biologists and paleontologists together in an attempt to compare the extinction rate seen in the fossil record with today's extinction record. These are "like comparing apples and oranges," Barnosky said. For one thing, the fossil record goes back 3.5 billion years, while the historical record goes back only a few thousand years. In addition, the fossil record has many holes, making it impossible to count every

species that evolved and subsequently disappeared, which probably amounts to 99 percent of all species that have ever existed. A different set of data problems complicates counting modern extinctions.

Dating of the fossil record also is not very precise, Marshall said.

"If we find a mass extinction, we have great difficulty determining whether it was a bad weekend or it occurred over a decade or 10,000 years," he said. "But without the fossil record, we really have no scale to measure the significance of the impact we are having."

To get around this limitation, Marshall said, "This paper, instead of calculating a single death rate, estimates the range of plausible rates for the mass extinctions from the fossil record and then compares these rates to where we are now."

Barnosky's team chose mammals as a starting point because they are well studied today and are well represented in the [fossil record](#) going back some 65 million years. Biologists estimate that within the past 500 years, at least 80 mammal species have gone extinct out of a starting total of 5,570 species.

The team's estimate for the average extinction rate for mammals is less than two extinctions every million years, far lower than the current extinction rate for mammals.

"It looks like modern extinction rates resemble mass extinction rates, even after setting a high bar for defining 'mass extinction,'" Barnosky said.

After looking at the list of threatened species maintained by the International Union for Conservation of Nature (IUCN), the team concluded that if all mammals now listed as "critically endangered,"

"endangered" and "threatened" go extinct, whether that takes several hundred years or 1,000 years, Earth will be in a true mass extinction.

"Obviously there are caveats," Barnosky said. "What we know is based on observations from just a very few twigs plucked from the enormous number of branches that make up the tree of life."

He urges similar studies of groups other than [mammals](#) in order to confirm the findings, as well as action to combat the loss of animal and plant species.

"Our findings highlight how essential it is to save critically endangered, endangered and vulnerable species," Barnosky added. "With them, Earth's biodiversity remains in pretty good shape compared to the long-term biodiversity baseline. If most of them die, even if their disappearance is stretched out over the next 1,000 years, the sixth [mass extinction](#) will have arrived."

Provided by University of California - Berkeley

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