PALEONTOLOGY

Mass Extinctions Face Downsizing, Extinction

Paleontologists are wondering whether mass extinctions were really all that massive —or, in the case of a 94-million-year-old example, whether they existed at all

A bunch of sea urchins turned up in the Cretaceous like a bad penny, millions of years after they were believed to have gone extinct. Their reappearance casts doubt on the existence of one long-presumed mass extinction and by implication that of several others. "This is going to shake up the paleo world for a while," says paleontologist Lisa Park of the University of Akron in Ohio.

Scattered among the five major crises in the history of life—such as the Cretaceous-Tertiary (K-T) extinction 65 million years ago that marked the end of the dinosaurs—are a half-dozen lesser extinction events, including the Cenomanian-Turonian (C-T) mass extinction 94 million years ago. These smaller events have long been prominent mileposts in the geologic record and examples of how life on Earth suffers under stress. But a new study threatens the very existence of the C-T. And because the other second-tier mass extinctions are defined by similar evidence, they may be suspect, too. Even the scale, although not the existence, of the Big Five mass extinctions is coming under scrutiny. All this because a group of British paleontologists, in a paper in the latest issue of *Paleobiology*, has removed European sea urchins from the list of C-T victims.

Paleontologists have estimated that 26% of marine genera known in the Cenomanian stage had disappeared by 94 million years ago when the Turonian stage began. That's hardly in the same class as the Big Five's 47% to 84% losses at the genus level, but it's still a pretty big deal.

But paleontologists Andrew Smith and Neale Monks of The Natural History Museum in London and geologist Andrew Gale of the University of Greenwich at Chatham Maritime wondered just how reliable the fossil record of the C-T is and thus how real the C-T extinctions were. They saw two potential problems. The known C-T record depends heavily on fossils recovered from rock outcrops in just two areas, Western Europe and the western interior of North America. These areas loom large in all of paleontology not because they harbor ideal fossil records but because they happen to be near the world's major institutions of paleontology of the past 2 centuries. And these records may be suspect because they come from sediments laid down when sea level was high, so high that Europe turned into an archipelago. Shallow seas on the continent would accumulate much less sediment than the continental shelf, and the fall in sea level since the C-T has given erosion 90 million years to remove the C-T fossil record deposited on the continents.

To see just how well the fossil record fared, Smith and his colleagues made a detailed study of sediments and echinoderm fossils—primarily sea urchins—already collected from southeastern England by Smith, Gale, and other colleagues. They also worked on sites in France and Germany. Twelve genera found in the 6-million-year-long Cenomanian made it through to the Turonian, but they found 29 Cenomanian genera that had disappeared from the rock record by the start of the Turonian. Apparently, the C-T extinction event claimed 71% of existing echinoderm genera.

Risen. This Cenomanian sea urchin disappeared from the fossil record for 30 million years.

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But appearances at the C-T are deceptive, Smith and his colleagues say. Fifteen of the 29 apparently extinct genera reappeared in the record as much as 20 million years after the Turonian, they found. These "Lazarus taxa" obviously had not disappeared from the world, only from the rock preserved in Western Europe around the C-T boundary. Another seven Cenomanian genera disappeared and never reappeared, but new genera so much like them later appeared that the new genera must have evolved from the Cenomanian genera, which therefore must not really have gone extinct, Smith concludes. By Smith's count, then, the C-T extinction of echinoderms shrinks from a catastrophic 71% to 17%, a loss that might simply reflect the background extinction that inevitably occurs at any time.

"I'm not saying there were no extinctions," says Smith. "I think we've been overestimating the magnitude of the extinctions." The problem, he says, is that shallow-water taxa—the sort preserved on the then-flooded continent—tend to be more abundant than taxa living in the deeper water of the continental shelf. When shallow-water sediments were lost right at the C-T, the remaining record contained far fewer taxa, creating the appearance of an extinction event.

Reaction to the Smith study is generally positive. "It's a cautionary note for the lesser extinction events," says paleontologist Anthony Hallam of the University of Birmingham, United Kingdom. "A query has to be put over how important the Cenomanian-Turonian is. Sea level does affect things the way they describe." For a more accurate view of the C-T, paleontologists will have to broaden their perspective. "By the accident of human history, our perception [of the C-T] is colored by what happened in Western Europe and North America," says paleontologist David Jablonski of the University of Chicago. "The jury is still out until we have a global assessment of the event" that includes shallow-water sediments that happened to survive from the C-T.

In the meantime, even the big ones are coming under closer scrutiny, because, like the C-T, most major extinction events come at times of rising sea level and are documented largely in Western Europe and North America. Even the biggest mass extinction, the Permian-Triassic of 250 million years ago, may not be as big as the 96% species extinction claimed for it, Park says.

In fact, last month paleontologist Johnny A. Waters of the State University of West Georgia in Carrollton and colleagues reported at the Earth System Processes meeting in Edinburgh that another of the Big Five—at the Frasnian-Famennian boundary 364 million years ago—isn't as big as it once seemed. Based on their recent finds in remote northwestern China and finds elsewhere, the number of echinoderm taxa following the boundary in the Famennian is five times greater than previously thought, they said, greatly diminishing the extinction event. "I'm not convinced the Frasnian-Famennian is a big deal," says Christopher Maples of Indiana University, Bloomington, a co-author of the work. Getting the scale and even the existence of mass extinctions right will require more explorations beyond merry old England. **–RICHARD A. KERR**