Census of modern organisms reveals echo of ancient mass extinction

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Bivalves predominate in this sample of marine organisms. Marine bivalves have been originating new species faster since the extinction of the dinosaurs than before, according to paleontologists at the University of Chicago and the University of California, Berkeley. Credit: Courtesy of Susan Kidwell

Paleontologists can still hear the echo of the death knell that drove the dinosaurs and many other organisms to extinction following an asteroid collision at the end of the Cretaceous Period 65 million years ago.

"The evolutionary legacy of the end-Cretaceous extinction is very much with us. In fact, it can be seen in virtually every marine community, every lagoon, every continental shelf in the world," said University of Chicago paleontologist David Jablonski. It is, he said, "sort of an echo of the big bang for evolutionary biology."

This conclusion followed a detailed global analysis of marine bivalves, one of the few groups plentiful enough in the fossil record to allow such a study, which was funded by the National Aeronautics and Space Administration. Andrew Krug of the University of Chicago, Jablonski and James Valentine of the University of California, Berkeley, examined the geologic ages of every major lineage of living bivalves the world over, from oysters and scallops to quahogs and cockles. Their report appears in the Feb. 6 issue of the journal *Science*.

International biological census

The team followed procedures similar to taking a census of everyone living in Chicago, inferring birth rates from that age profile, and then comparing them to a census for Tokyo, Mexico City and other major international metropolitan areas.

Their analysis quantified the time of origin for 711 lineages of bivalves living in the oceans today, and converted them to evolutionary origination rates. In all but the highest-latitude locations, the team saw the clear signs of a strong increase in origination rates following the end of the Cretaceous.

That was no great surprise, Jablonski said, because "the post-extinction recovery pulse is dramatic—we've known about it for a long time." The surprising finding was that the initial 10 million-year boom never really went bust. The origination rate slowed a bit, but did not drop back to the levels that preceded the mass extinction. "It was as if the post-war baby boom birth rate slowed slightly but never returned to pre-war levels," he said.

Why the origination rate failed to drop to previous levels remains an unsolved question, "one that we never even would have asked if we hadn't analyzed the data in this new way," Jablonski noted. "It could be

that the extinction took out competitors that had been holding the bivalves back, and permanently opened more room to diversify. Or the post-extinction increase in predation by crabs, fish and other enemies may have spurred the bivalves to keep evolving at a faster pace." These will be interesting ideas to test next, according to Jablonski.

There's a subtlety to the findings. "These data don't mean that the extinction was less severe at high latitudes. They mean that the recovery was less prolific at high latitudes," he said.

Tropical recovery engine

The difference reflects the lag between when lineages arise in the tropics and when they finally make it up into polar waters. "The tropics were the engine of the recovery, and they just kept on pumping out new lineages," Jablonski said, while the poles slowly collected lineages spreading out from warmer zones.

The paper culminated a discussion among the authors that had nothing to do with the end-Cretaceous extinction, said Krug, a Postdoctoral Scholar in Geophysical Sciences at Chicago. They were following up other work that Krug had done on the interplay between the geographic range, age and species composition of modern lineages.

When they compared the data from several provinces, Krug noticed the same statistical blip in each—a sharp kink in the curve summing up the ages of living lineages. "When we saw that the kink fell right at 65 million years ago, we knew we had something," Jablonski said. Upon further analysis, a significant pattern emerged for origination rates, an evolutionary signal that had withstood 65 million years of later global changes in climate, geography and ecology.

"It turned out to be supported in almost all the provinces, and the

strength of that support was predictable based on latitude of the province," Krug said. "We'd found a pattern no one had ever seen before. It was an exciting moment."

Source: University of Chicago