Dramatic shift from simple to complex marine ecosystems occurred 250M years ago at mass extinction

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The earth experienced its biggest mass extinction about 250 million years ago, an event that wiped out an estimated 95% of marine species and 70% of land species. New research shows that this mass extinction did more than eliminate species: it fundamentally changed the basic ecology of the world's oceans.

Ecologically simple marine communities were largely displaced by complex communities. Furthermore, this apparently abrupt shift set a new pattern that has continued ever since. It reflects the current dominance of higher-metabolism, mobile organisms (such as snails, clams and crabs) that actually go out and find their own food and the decreased diversity of older groups of low-metabolism, stationary organisms (such as lamp shells and sea lilies) that filter nutrients from the water.

So says research to be published in *Science* on November 24, 2006. An accompanying article suggests that this striking change escaped detection until now because previous research relied on single numbers--such as the number of species alive at one particular time or the distribution of species in a local community--to track the diversity of marine life. In the new research, however, scientists examined the relative abundance of marine life forms in communities over the past 540 million years.

One reason they were able to do this is because they tapped the new

Paleobiology Database, a huge repository of fossil occurrence data. The result is the first broad objective measurement of changes in the complexity of marine ecology over the Phanerozoic.

"We were able to combine a huge data set with new quantitative analyses," says Peter J. Wagner, Associate Curator of Fossil Invertebrates at The Field Museum and lead author of the study. "We think these are the first analyses of this type at this large scale. They show that the end-Permian mass extinction permanently altered not just taxonomic diversity but also the prevailing marine ecosystem structure."

Specifically, the data and analyses concern models of relative abundance found in fossil communities throughout the Phanerozoic. The ecological implications are striking. Simple marine ecosystems suggest that bottom-dwelling organisms partitioned their resources similarly. Complex marine ecosystems suggest that interactions among different species, as well as a greater variety of ways of life, affected abundance distributions. Prior to the end-Permian mass extinction, both types of marine ecosystems (complex and simple) were equally common. After the mass extinction, however, the complex communities outnumbered the simple communities nearly 3:1.

The other authors are Scott Lidgard, Associate Curator of Fossil Invertebrates at The Field Museum, and Matthew A. Kosnik, from the School of Marine and Tropical Biology at the James Cook University in Townsville, Queensland, Australia.

"Tracing how marine communities became more complex over hundreds of millions of years is important because it shows us that there was not an inexorable trend towards modern ecosystems," Wagner said. "If not for this one enormous extinction event at the end of the Permian, then marine ecosystems today might still be like they were 250 million years ago."

These results also might provide a wake-up call, Wagner added: "Studies by modern marine ecologists suggest that humans are reducing certain marine ecosystems to something reminiscent of 550 million years ago, prior to the explosion of animal diversity. The asteroid that wiped out the dinosaurs couldn't manage that."

Lidgard added, "When Pete walked into my office with his preliminary results, I simply couldn't believe them. Paleontologists had long recognized that ecosystems had become more complex, from the origin of single-celled bacteria to the present day. But we had little idea of just how profoundly this one mass extinction--but not the others like it--changed the marine world."

Source: Field Museum