

## PALEOBIOLOGY

# Revised Numbers Quicken the Pace of Rebound From Mass Extinctions

Paleontologists found it hard to believe that some sort of Darwinian traffic cop was slowing the biosphere's recovery from major extinctions. But that's what the past half-billion years of marine fossils seemed to tell them. Read literally, this history of life said it took 5 million to 10 million years for new species to begin replacing the losses suffered during extinctions. That would be bad news for a modern biosphere battered by a human-induced mass extinction.

But now researchers have taken a second look at the fossil record after trying to remove some of its imperfections. "The biosphere seems to be more volatile, more responsive to perturbations" than it had seemed, says evolutionary biologist Charles Marshall of Harvard University, an author of the paper in the 21 February issue of the *Proceedings of the National Academy of Sciences*. In this revised history, at least, there's no cop to hold life back.

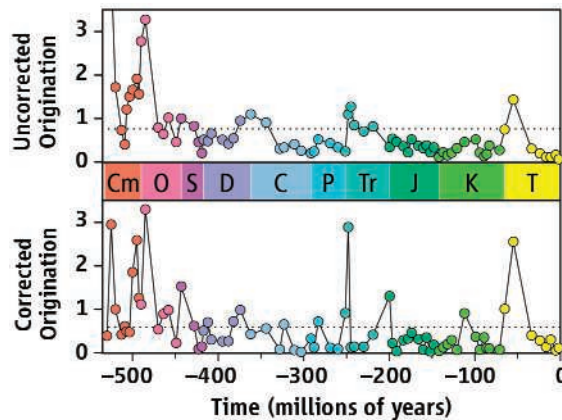
The new reanalysis was a serendipitous affair. Harvard physics graduate student Peter Lu\* learned about the well-known marine fossil record compiled by the late paleontologist Jack Sepkoski while taking courses from Marshall. Lu had "grown up collecting rocks," so the paleontology courses were in the line of recreation. Lu in turn showed the record to his former Harvard roommate Motohiro Yogo, who is now an assistant professor of finance at The Wharton School of the University of Pennsylvania.

Sepkoski's raw data had already been analyzed by geoscientist James Kirchner of the University of California, Berkeley, and paleontologist Anne Weil of Duke University in Durham, North Carolina. Their results suggested "intrinsic limits" on the biosphere that "imply that today's anthropogenic extinctions will diminish biodiversity for millions of years to come," they wrote. Either a post-extinction world is environmentally inimical to life for millions of years, paleontologists speculated, or all that time was needed to rebuild a ruined food web.

Economist Yogo had another idea: Why not analyze the record of life using vector autoregression? That is a technique commonly used to forecast the performance of the stock market

or the economy from past behavior. When applied to Sepkoski's raw record of when genera first appeared and last appeared in the record, it suggests that "things move kind of slowly," says Lu; the record displayed the same evolutionary inertia Kirchner and Weil found.

The Harvard group then analyzed a modified version of the record. Paleontologist Michael Foote of the University of Chicago in Illinois had attempted to take account of known biases in the fossil record, such as the varying amount of exposed fossil-bearing rock found in different geologic time intervals. With such revisions, "the speed limit dis-



**New lease on life.** Jumps in the rate at which new genera appear in the fossil record seem to be delayed and protracted (*top*) until the record is corrected (*bottom*).

appears," says Lu. In general, there's no delay between extinction and recovery, although there may be exceptions, such as after the great Permian-Triassic mass extinction.

The new analysis is being received with a mix of caution and relief. "We all wish we had the real history of life," says Kirchner. "We don't and never will, [so] we try to account for the imperfections." In this latest effort, whether the revised pattern of evolution as analyzed by the Harvard group "is real or artificial is very hard to sort out," Kirchner says. "The error bars can be large."

Paleontologists such as Douglas Erwin of the National Museum of Natural History in Washington, D.C., find the new result "makes a great deal more biological sense than the prolonged delay" of recoveries. However it plays out, "this is the battle line for the next decade in paleontology," says paleontologist Steven Holland of the University of Georgia, Athens. "We're going to see a new wave of analyses that take incompleteness [of the fossil record] into account. Our view of evolutionary patterns is going to change."

—RICHARD A. KERR

## Innovation Craze Hits China

**BEIJING**—China has unveiled an ambitious 15-year plan for ditching its follow-the-leader approach to R&D in favor of one that prizes innovation.

The plan calls for boosting spending on R&D from 216 billion yuan (\$26 billion) in 2004 (1.4% of GDP) to 900 billion yuan (\$110 billion) in 2020 (an estimated 2.5% of GDP). The plan identifies 16 state projects, including human space flight and broadband wireless communications, and four priority basic science programs: protein sciences, reproductive biology and development, nanotechnology, and quantum mechanics. Chinese Academy of Sciences biophysicist Zou Chenglu says the blueprint is "generally good. . . . But it leaves limited room for basic science."

—GONG YIDONG

## Grantee Granted Reprieve

The U.S. Bureau of Land Management (BLM) has reinstated funding for a study published in *Science* that determined that logging after wildfires harms a forest's recovery (*Science*, 10 February, p. 761). BLM had suspended the \$300,000 grant to Oregon State University (OSU) while it investigated whether the authors had used their paper to lobby against pending federal legislation that would facilitate salvage logging in national forests.

OSU says that a reference to the pending legislation inadvertently left in by *Science* editors was not supposed to have appeared in the online version of the paper.

Representative Greg Walden (R-OR), who has introduced the salvage logging bill, will chair a field hearing in Medford, Oregon, next week on the implications of the paper.

—ERIK STOKSTAD

## Taira on Offensive

**TOKYO**—Kazunari Taira, a University of Tokyo chemist whose research results have been questioned, is fighting back. Last month, a university investigating committee concluded that no one could reproduce the results in several of his published RNA studies (*Science*, 3 February, p. 595). In a 4 February letter, Taira called the committee's report "one-sided [and] exaggerated." He says he was not given an opportunity to respond, and he wants a new investigation. Kimihiko Hirao, the university's engineering school dean, defended the investigation in a statement the same day, pointing out that Taira's group was not able to produce any raw data for the disputed work. Another committee is considering his punishment.

—DENNIS NORMILE