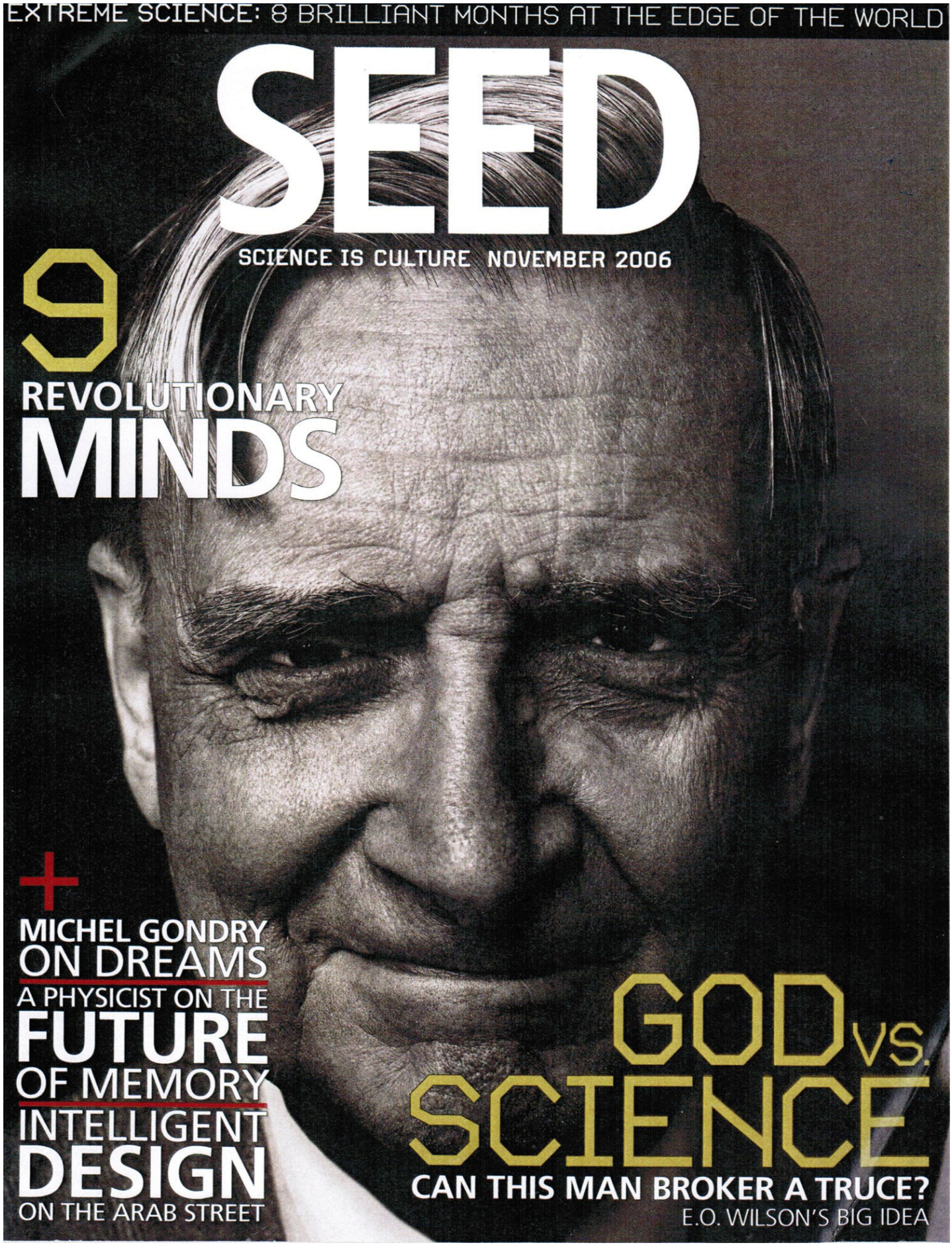
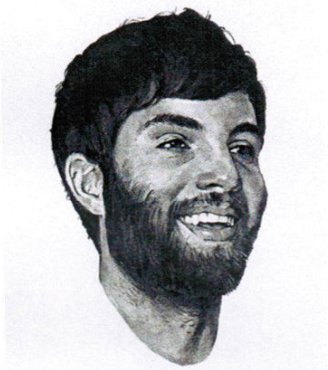

EXTREME SCIENCE: 8 BRILLIANT MONTHS AT THE EDGE OF THE WORLD
SEED
SCIENCE IS CULTURE NOVEMBER 2006
9
REVOLUTIONARY
MINDS
+
MICHEL GONDRY
ON DREAMS
A PHYSICIST ON THE
FUTURE
OF MEMORY
INTELLIGENT
DESIGN
ON THE ARAB STREET
GOD vs.
SCIENCE
CAN THIS MAN BROKER A TRUCE?
E.O. WILSON'S BIG IDEA

CONTRIBUTORS



Despite just being named one of the "10 Best Young Photographers in America," by *American Photo Magazine,* Mark Mahaney says his photo shoot with E.O. Wilson was a humbling experience. (The Synthesizer) "At my age, 26, Wilson was already a tenured professor at Harvard," Mahaney says. "I don't think I've ever used the word 'badass' before, but it's the best description I have for him."

Though PZ Myers tends to see eye-to-eye with outspoken atheist Richard Dawkins about the dangers of religion, Dawkins's new book, *The God Delusion*, did offer some surprises. "He's fighting smarter, I think," says Myers, a developmental biologist at the University of Minnesota. Renowned on ScienceBlogs for his prolific posting and a gleeful obsession with squid and other cephalopods, Myers will be bringing his insightful commentary to *Seed* via a new regular column starting next issue.

48 *Seed*'s former deputy art director Thomas Porostocky designed this issue's postcards for teachers, inspired by memories of his high school science lab in Calgary, Alberta. "It seemed with every experiment you could either a) produce some pretty crystals, or b) cause your left arm to fall off," he says. "Forget Texas—don't mess with science!" Porostocky's latest project, More Party Animals (morepartyanimals.com), aims to promote wider voter choice in the American political system.

24 "Taken by itself, extinction is the funeral of an organism," says Jason Stevenson (Cribsheet). He admits the topic is "a natural downer," but points out that "extinction is entirely necessary for the advancement of organisms." Though he's the only member of his family without a scientific degree or career, Stevenson says he relishes sifting through mountains of data and conflicting theories to accurately inform readers. He lives in Emmaus, Pennsylvania.

44 Interviewer Amanda Leigh Haag was first introduced to E.O. Wilson's work about 10 years ago while beginning her undergraduate biology degree (The Synthesizer) "I'd struggled with wanting to major in everything," she says. "But I thought that if I chose one, it was an irreversible decision, and that I'd somehow have to leave my passion for the others behind. Reading Wilson helped me see that these disciplines were actually deeply connected."

20 As chair of the National Academies' EPP2010 committee, Harold T. Shapiro has plenty to say about the future of the US particle physics program (Opinion): "My overall concern was to find the best means of supporting science that also represents a responsible use of public resources." Prior to this most recent contribution to American science, Dr. Shapiro served as vice chair of the President's Council of Advisors on Science and Technology, and chair of the National Bioethics Advisory Commission.

CRIBSHEET#7

EXTINCTION

KEY QUESTION IN EXTINCTION:

How much will the loss of potentially useful plant and animal species impact the future of human civilization?

More than 99% of all the life that ever existed on Earth is now extinct. Many species vanished in Earth's five major **mass extinctions**—geologically brief periods of time when large numbers of species died off. In order, they are:

- End Ordovician (445 MYA)
- Late Devonian (365 MYA)
- End Permian (250 MYA)
- End Triassic (200 MYA)
- End Cretaceous (65 MYA)

There are two broad causes of extinction: **catastrophe** and **competition**.

CATASTROPHE

Catastrophic extinction occurs when environmental changes happen faster than a species can migrate or adapt to survive. An **asteroid** or **comet impact**, the likely culprit in the disappearance of the **dinosaurs** at the end of the **Cretaceous** period, is a prime example of rapid and global catastrophic extinction. Gradual **climate change** has also caused mass extinction. In the **Ordovician** event, extensive glaciation on landmasses reduced sea levels, exposing and devastating the organism-rich continental shelves. Some examples of catastrophic extinctions are:

1. A volcanic eruption rapidly wipes out a localized species.
2. Glaciation slowly drains, cools, and deoxygenates an aquatic environment, threatening a species's survival.

COMPETITION

Rivalry can also result in extinction when one species outcompetes another. For example, competition with *Homo sapiens* might have led to the extinction of **Neanderthals** some 30,000 years ago. A species can even evolve to compete against itself. Here is a hypothetical scenario:

1. A newly formed river isolates some members of a species.
2. Environmental pressures select for new traits.
3. Over time a new species evolves.
4. If beneficial adaptations have occurred, intermingling could eliminate the original species.

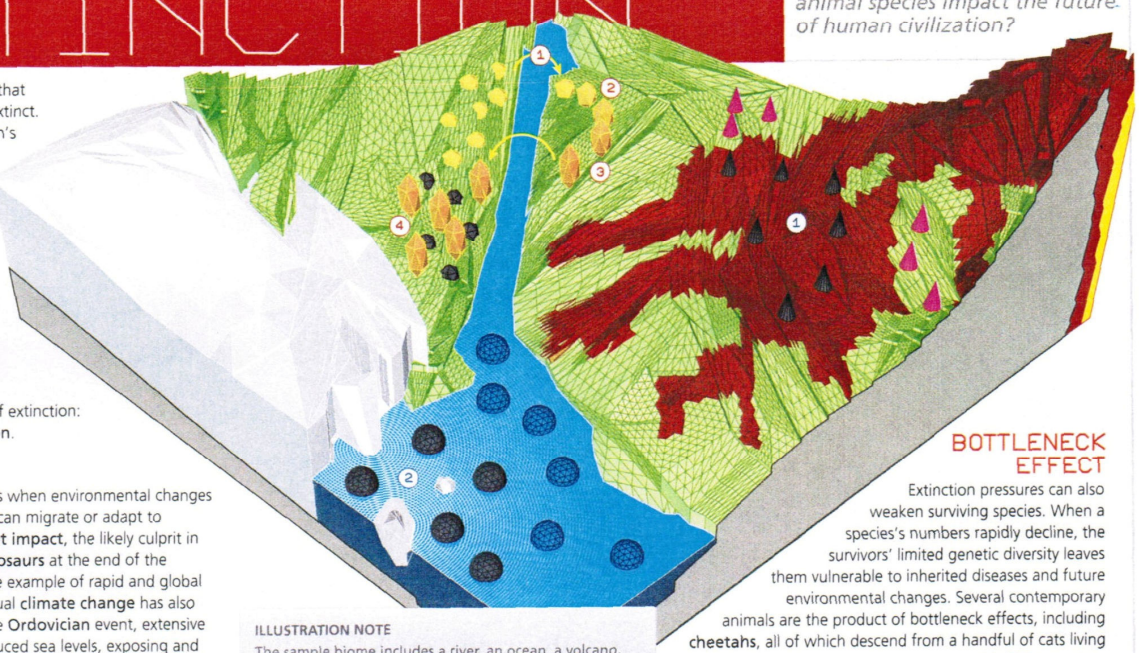


ILLUSTRATION NOTE
The sample biome includes a river, an ocean, a volcano, and a glacier. Geometric shapes such as spheres, cones, and icosahedrons indicate different species, and deceased organisms are darkened.

EXTINCTION AND SPECIATION

Extinction appears to be vital for the creation of new species. Pressures from mass-extinction events typically select for genetic innovation. This usually results in the rapid expansion of new species with better adaptations for inhabiting ecological niches vacated by vanished organisms. Strangely, two mass extinctions, the **Devonian** and the **Triassic**, were characterized not only by increased extinction rates, but also below-average speciation rates, amplifying the loss of biological diversity. Scientists aren't yet in agreement about the causes of these two extinctions.

BOTTLENECK EFFECT

Extinction pressures can also weaken surviving species. When a species's numbers rapidly decline, the survivors' limited genetic diversity leaves them vulnerable to inherited diseases and future environmental changes. Several contemporary animals are the product of bottleneck effects, including **cheetahs**, all of which descend from a handful of cats living 10,000 years ago.

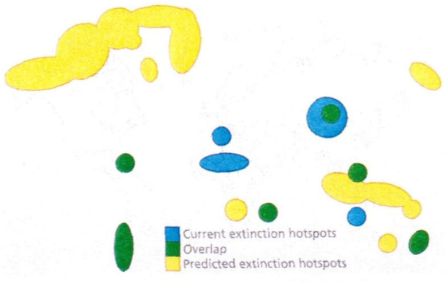
FUNCTIONAL EXTINCTION

Even when a catastrophe or competition spares some members of a species, if the survivors are unable to successfully reproduce, the species cannot recover and is functionally extinct, or **committed to extinction**. **Passenger pigeons** became functionally extinct in North America in the early 1900s after widespread hunting reduced their numbers below sustainability.

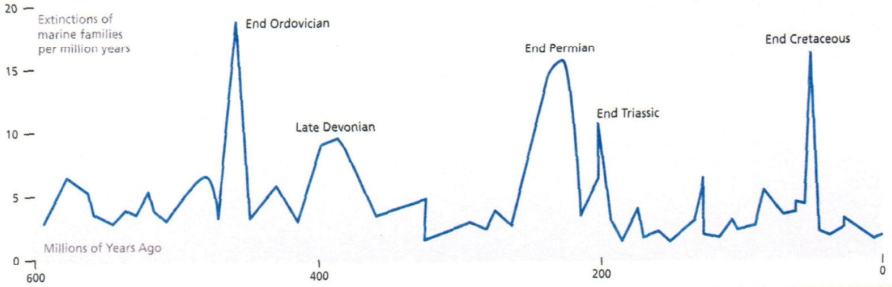
COEXTINCTION

Extinction of a single species can cause cascading additional extinctions of other organisms that rely upon it for survival. **Parasites** are common victims of coextinction, but highly specialized predators, scavengers, herbivores, and plants requiring specific pollinators are also at risk.

PREDICTED EXTINCTION HOTSPOTS



FREQUENCY OF PAST MASS EXTINCTIONS



THE ISSUE: ARE HUMANS CAUSING ANOTHER MASS EXTINCTION?

Some scientists blame humanity for a sixth, modern extinction. The World Conservation Union (IUCN) has documented the disappearance of 784 species since the year 1500, while the group's 2006 Red List identified 16,000 species facing extinction. Climate change played a key role in one of Earth's five mass extinctions, and recent studies show that global warming threatens the Arctic habitats of polar bears and other species. More research is needed, however, to determine if the current level of extinctions is "natural," or if it signifies the leading edge of a mass extinction from anthropogenic climate change.

SOUNDBITE

Current levels of global climate change threaten 25% of all land-based plants and animals with extinction by 2050.

Soundbite Source: CD Thomas et al. (2004) "Extinction risk from climate change." Nature 427:145-148.
Graph data: Raup DM, Sepkoski JJ (1982) "Mass extinctions in the marine fossil record." Science 215:1501-1503.