EXTINCT IN THE WILD

Panamanian Golden Frog

Native to Central Panama, the frogs were driven to extinction by deforestation, water pollution, the illegal pet trade, and the spread of an amphibian-killing fungus.

The Sixth EXTINCTION?

Many scientists agree that we're headed for another mass extinction like the one that wiped out the dinosaurs

BY ELIZABETH KOLBERT

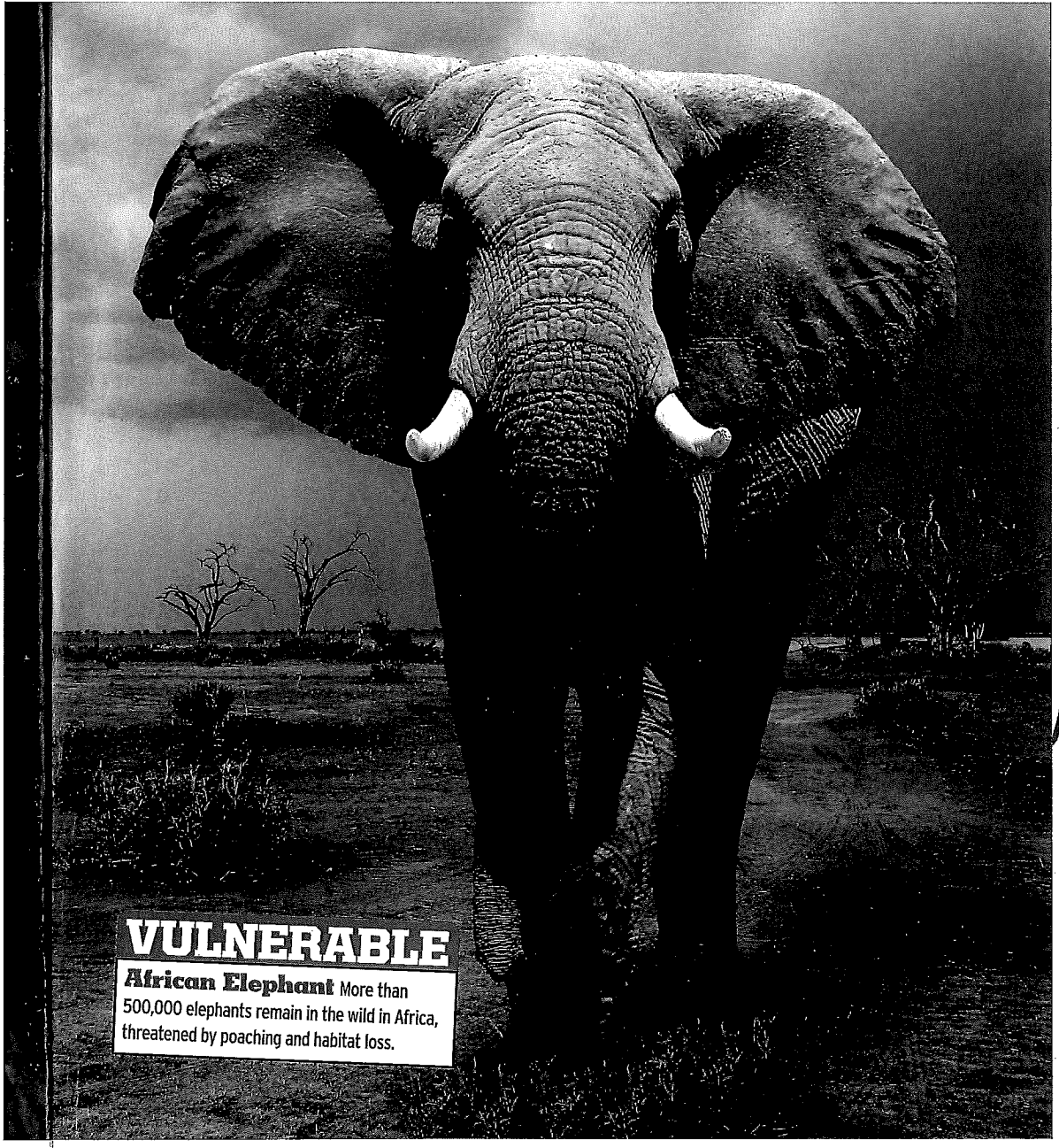
Something was killing the frogs of Central America—and it was killing them fast.

One of the first to notice was Karen Lips, an American graduate student studying amphibians in the rainforest there. In 1993, she was shocked to discover that all the frogs had vanished from her research site in Costa Rica. When she later relocated to Panama, she found that the frogs were dying there too. And no one could explain why.

Whatever was killing the frogs continued to move, like a wave, across Panama. By 2006, it had swept across the central part of the country, home to the Panamanian golden frog, famous for being so toxic that the poison on the skin of just one could kill a thousand mice. Soon afterward, the golden frog was declared extinct in the wild.

The recent demise of the frog, along with dozens of other brightly colored amphibians in Central America, is part of a much larger phenomenon that's been dubbed the Sixth Extinction. Extinction rates today are probably higher than they've been at any point since the dinosaurs disappeared 65 million years ago. Frogs and toads are the world's most threatened group of animals—nearly 40 percent are endangered—but extinction rates among pretty much all groups are soaring. A century from now, pandas, tigers, and rhinos may well exist only in zoos. And most coral reefs, home to thousands of underwater species, are

To learn more about elephant poaching, watch a video at www.upfrontmagazine.com



ZSSD/MINDEN PICTURES (FROG); BUENA VISTA IMAGES/THE IMAGE BANK/GETTY IMAGES (ELEPHANT); SHUTTERSTOCK (ANIMAL SILHOUETTES)

threatened. Within this century, 20 to 50 percent of all living species—from plants to mammals—might be headed toward oblivion.

While the forces behind the Sixth Extinction vary, trace them back far enough and you get to the same source: us. By inhabiting every corner of the planet, razing forests, and burning fossil fuels, people are changing the world so fast that many other species can't cope.

"We're seeing right now that a mass extinction can be caused by human beings," says Walter Alvarez, a scientist at the University of California, Berkeley.

Cold Snaps & Asteroids

For most of human history, people had no idea that creatures went extinct. When Thomas Jefferson became president in 1801, he seriously expected that live mastodons would be found roaming the American West.

But around the same time, while working at the museum of natural history in Paris, a French naturalist named Georges Cuvier realized that a lot of the bones in the museum's collection belonged to animals that no longer existed.

"Life on Earth has often been disturbed by terrible events," Cuvier wrote. "Living things without number have been the victims of these catastrophes."

Over the next several decades, many scientists—including Charles Darwin—helped develop the scientific concept of extinction. Today, most scientists agree that the world usually changes very slowly. In ordinary times, species rarely go extinct: Scientists estimate that under normal

ALREADY GONE

Almost 900 species are known to have gone extinct, or extinct in the wild, since 1500

- Mollusks **324**
- Birds **145**
- Flowering Plants **123**
- Mammals **79**
- Fishes **72**
- Insects **58**
- Amphibians **36**
- Reptiles **22**
- Crustaceans **12**
- Non-flowering Plants **11**
- Arachnids **9**
- Others **6**

circumstances, one amphibian species disappears every 1,000 years or so.

But sometimes, the world changes very suddenly. In those rare moments of rapid change, species disappear much more quickly. These events are known as mass extinctions.

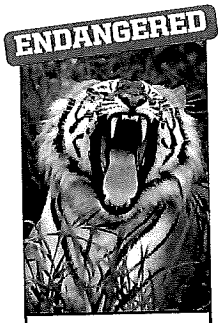
Since complex life evolved, about a half billion years ago, there have been five major mass extinctions called the Big Five *(see below)*. The first one took place 444 million years ago, when creatures like trilobites, which resembled horseshoe crabs, and conodonts, which looked like eels, roamed the oceans. The extinction was most likely caused by a sudden global cold snap and killed roughly 80 percent of all species in the seas.

The most recent of the Big Five was caused 65 million years ago by a six-mile-wide asteroid that was traveling at 25,000 miles per hour when it hit Earth in what is now the Gulf of Mexico. Exploding on contact, the asteroid released as much energy as a million of the most powerful nuclear bombs ever tested. Debris spread around the globe, day turned to night, and temperatures plunged.

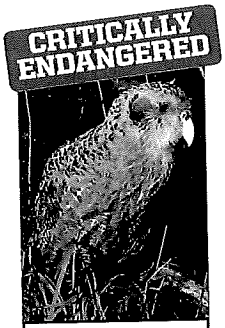
In addition to the dinosaurs, 75 percent of the other species on Earth—everything from pterosaurs to ammonites, and also many snakes, birds, and mammals—died off. The world that we live in today is very much a product of this event. After the impact, those mammals that survived evolved to fill the niches the dinosaurs had occupied. In a very real sense, you are here today only because of that extinction.

A New Mass Extinction

Today, most scientists believe we're witnessing a new mass extinction. Across all sorts of different groups, extinction rates are now up to 10,000 times higher than they were before humans appeared, according to a recent report in *Science* magazine. Among the animals threatened today are pandas, gorillas, and rhinos—and many other lesser-known species, like the kakapo, a flightless parrot in New Zealand, and the Franklin's bumblebee, in Northern California.



Tiger
In the past century, 97 percent of wild tigers in Asia have disappeared because of habitat loss, poaching, and rising sea levels. As few as 3,200 remain.



Kakapo
Native to New Zealand, fewer than 150 remain. Their demise was due to deforestation and the introduction of predators like cats and rats by Polynesian and European settlers.

This time, a giant asteroid isn't to blame. We are, most scientists agree. Because of human activity, Earth is now changing very fast—probably faster than at any point since the asteroid impact.

How are we doing this? One way is by moving species around the globe. Before boats (and then planes) were invented, it was almost impossible for a land species to cross an ocean or a marine species to cross a continent, and it happened very rarely. But today, as the pace and volume of global trade have picked up, so too has the number of accidental imports. Species that couldn't survive an ocean crossing at the bottom of a canoe or the hold of a whaling ship may easily withstand the same journey on a modern cargo ship or in a tourist's suitcase. An estimated 10,000 species are being moved around every day just in the ballast water of supertankers—undoing millions of years of geographic separation.

Moving species around can have devastating consequences: New species can become invasive and, in the long run, they can drive native species into extinction.

Hawaii, for example, is acquiring a new species each month, according to the Center for Invasive Species Research. The result? Hundreds of species that existed only in Hawaii for thousands of years—including a variety of land snails, birds, ferns, and flowers—are now gone forever or disappearing because other species have taken over.

When scientists finally figured out what was killing the amphibians in Central America, it turned out to be a fungal disease that had arrived with non-native frogs. (Scientists haven't pinpointed which species.) The disease has also killed amphibians in North and South America, Australia, and the Caribbean.

Another way people are changing the planet is by cutting down forests and burning fossil fuels like oil and coal. That has led to a buildup of carbon dioxide and other gases that trap heat in the atmosphere, which is causing Earth to warm up. The changing temperatures force species to adapt to new climates

THE BIG 5

The first five mass extinctions were caused by dramatic events that resulted in a sharp loss of diversity on Earth.

1 444 million years ago

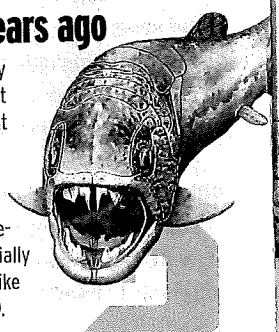
The first mass extinction was caused by a rapid growth in glaciers and dramatic drops in sea levels.

Species affected: Marine organisms like conodonts and trilobites *(above)*

2 360 million years ago

This mass extinction may have had two phases, but very little is known about why it happened.

Species affected:
Three-quarters of all species disappeared, especially those living in the sea, like the Dunkleosteus *(right)*.



PAGES 14-15: GERRY ELLIS/MINDEN PICTURES (TIGER); STEPHEN BELCHER/MINDEN PICTURES/CORBIS (KAKAPO); THE NATURAL HISTORY MUSEUM/THE IMAGE WORKS (TRILOBITE); DORLING KINDERSLEY/GETTY IMAGES (DUNKLEOSTEUS); ISTOCKPHOTO.COM (SEA SCORPION); THE NATURAL HISTORY MUSEUM/THE IMAGE WORKS (THRINAXODON); SHUTTERSTOCK (TYRANNOSAURUS REX); UIG VIA GETTY IMAGES (BABY MAMMOTH)

Scientists inspect the 40,000-year-old carcass of a baby mammoth in Russia in 2007.

RAISING THE DEAD?

Scientists could bring extinct species back to life. But should they?

With species continuing to disappear, scientists are working on bringing some of them back to life. Though it could increase biodiversity, de-extinction is tricky: To resurrect a species, scientists need its DNA—which is hard to recover for animals that died off thousands of years ago, like the woolly mammoth. Even if technology allows us to bring back extinct animals, should we do it? Opponents fear that long-gone creatures could hurt today's ecosystems. But supporters argue that many species vanished because of humans, so it's up to us to reverse extinction. Says paleontologist Mike Archer: "I think we have a moral responsibility to fix what we broke." —*Alessandra Potenza*

or move to cooler habitats. If neither of those strategies works, they die out. For many species, the latter outcome is the more likely one.

But it's not all grim. Thousands of scientists all over the world are trying to reverse the trend *(see "Raising the Dead?")*. In Panama, a conservation center is filled with tanks containing endangered frogs—including Panamanian golden frogs. They're equipped with running water so the animals can breed near a facsimile of the streams that were once their home.

The U.S. Congress passed the Endangered Species Act in 1973, and since then the length to which people have gone to protect vulnerable creatures is incredible. To save the whooping crane, whose population in the wild is down to 200, volunteers fly ultralight aircraft each year to teach chicks raised in captivity how to migrate from Wisconsin to Florida for the winter. The 1,300-mile journey can take up to three months, with a dozen stops on private land that owners give over to the birds.

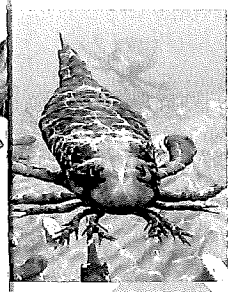
Homo sapiens might be not just the agent of the Sixth Extinction but also a victim.

And millions of Americans donate to groups like the World Wildlife Fund, the National Wildlife Federation, and the Nature Conservancy.

But despite all these efforts, what matters the most is that people are changing the world—and, with it, the biodiversity we depend on to raise animals and crops, feed ourselves, and survive. Millions of years from now, the planet will be inhabited only by the descendants of those creatures that survive this new mass extinction. And it's not taken for granted that we will be among them.

"*Homo sapiens* might not only be the agent of the Sixth Extinction," says anthropologist Richard Leakey, "but also risks being one of its victims." ●

Elizabeth Kolbert is a staff writer for The New Yorker and author of "The Sixth Extinction: An Unnatural History."



3 250 million years ago

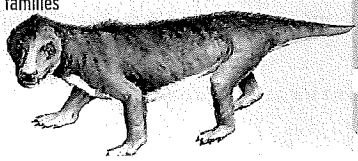
The deadliest of all mass extinctions was either caused by the impact of an asteroid or comet, or by massive volcanic eruptions in what is now Siberia.

Species affected: 90 percent of all species died, including sea scorpions *(left)*.

4 200 million years ago

This extinction was probably caused by massive floods of lava erupting underneath what is now the Atlantic Ocean.

Species affected: Most mammal-like creatures (like the Thrinaxodon, *below*), large amphibians, and 20 percent of all marine families



5 65 million years ago

This extinction was most probably caused by an asteroid that hit Earth and ejected tons of debris into the atmosphere, darkening the skies for months.

Species affected: Dinosaurs (like the T. rex, *below*) and 75 percent of all species