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# So You're Extinct? Scientists Have Gleam in Eye

By GINA KOLATA

Until recently, the arrow of natural selection seemed to go only one way. A species could form, then it could flourish, then it could go extinct. And once it was extinct, it could not come back.

Now, though, some scientists say they see a new path.

“Maybe we can no longer delay death, but we can reverse it,” said George Church, a Harvard Medical School geneticist.

For now, only one extinct subspecies has been brought back, and the baby animal that was born lived just minutes in 2003. It was a Pyrenean ibex, a large goatlike creature that prowled the cliffs in the Pyrenees between Spain and France until the last one died in 1999. The method used was cloning — using frozen cells of the last of the animals to try to create a new one, much like [Dolly the sheep](#) was cloned from a frozen udder cell of a sheep that had died years before.

Last week at a conference in Washington, scientists from Australia reported on their attempt to bring back a weird frog, the Southern gastric brooding frog, that went extinct about a quarter century ago. So far they have only made early embryos, which have died.

It is the early days for this new endeavor — it could be years before scientists succeed in bringing species back from extinction. But many species are now gleams in scientists' eyes as they think of ways to bring them back. Woolly mammoths. A 70,000-year-old horse that used to live in the Yukon. Passenger pigeons, a species that obsessed Dr. Church's former student.

Some sound a note of caution.

Ross MacPhee, curator of mammals at the American Museum of Natural History, said that while the science of bringing back extinct species is fascinating, “as usual, our technological capacity outstrips what it all means.”

“Who will be doing this and what are the regulations? These are getting lost in the hoopla,” Dr. MacPhee said.

And should humans bring back extinct species even if they can? The questions are practical as well as ethical, issues of unintended consequences.

Before humans killed them, the nation had three billion to five billion passenger pigeons. They would take days to cross a city, noted Hank Greely, the director of the Stanford Center for Law and the Biosciences at Stanford University. “They left cities covered in an inch of guano,” he said.

The science of bringing back extinct species is complex, and the task can seem a bit daunting. Actual cloning requires an intact cell from an extinct species, something that might not exist. Some scientists have speculated that there might be intact frozen cells of extinct species like woolly mammoths in the earth’s permafrost but others, like Dr. Church, say they doubt it. He and most others, he said, believe all that can be found in the permafrost is broken DNA.

If cloning works, it results in an embryo that must be implanted in a closely related species to serve as a surrogate mother.

But new DNA technologies have suggested another way to bring back extinct species, and all that is needed is some genetic material. The idea is to compare the DNA of the extinct species to that of a closely related existing species and then start substituting chunks of the extinct species’ DNA into the DNA in cells of the existing species. Then those hybrid cells would be used to clone. After a while, the resulting bird or animal would have enough of the extinct species’ DNA to closely resemble it.

This is not a method that could be used to create Jurassic Park, though, because there appears to be no dinosaur DNA.

Another method is to backbreed. That might work, for example, with the aurochs, an ancient breed of wild cattle. It is thought that most of its distinctive genes still exist, scattered among existing cattle strains. Scientists could breed those existing strains, selecting for offspring with more and more and more of the auroch DNA until they got cattle that were close to aurochs.

In theory — a wild theory — backbreeding humans might even enable scientists to bring back Neanderthals, Mr. Greely said. About 2 to 3 percent of human DNA seems to be relics of Neanderthal DNA, he said, and different people have different Neanderthal DNA segments. Of course, he added, “a 500-generation backbreeding among humans is not feasible.” And, he added, “It would be a really bad idea.”

But there could be some unexpected advantages to bringing back certain species, or even to adding their DNA to that of today's species, Dr. Church said. For example, suppose elephants could live again in the Arctic. When woolly mammoths lived in the Arctic they would knock down trees and enable Arctic grasses to flourish. Without trees, more sunlight was reflected and the ground was cooler. In winter, they would tramp down snow into the permafrost, enhancing it.

“Permafrost has two to three times more carbon than all the rain forests put together,” Dr. Church said. “All you have to do to release carbon dioxide and methane is to melt it. With rain forests you have to burn it.”

“What if all we have to do is bring back cold-resistant elephants?” Dr. Church said.

Of course, there are many arguments against fooling with nature in this way.

One is the consequences for the Endangered Species Act. Its premise, Mr. Greely pointed out, is that extinction is forever.

“If you take away that argument, what happens?” he asked. “Suppose developers want to build on a last bit of land where an endangered bird lives. And suppose they say, ‘We will be happy to pay for freezing. Now let us build our golf course.’ ”

Mr. Greely cited another argument in favor of bringing back extinct species. He did not quite buy it, he said, but for him it had “a visceral appeal.”

It is an argument about justice. Take the passenger pigeon. “We are the murderers,” Mr. Greely said. “We killed them off. Shouldn't we bring them back?”

But that raises questions, he added. “Do we owe duties of justice to nonhuman species? If so, where do we draw the line? How much money do we have to spend? How many species do we have to bring back?”

In the end, a sense of wonder draws Mr. Greely and many others to the idea of bringing back species.

“For me, it's just would just be so cool to see a woolly mammoth or a saber tooth tiger or a ground sloth,” Mr. Greely said.

“We are not talking Jurassic Park,” Mr. Greely said. “We are talking Pleistocene Park, 100,000 or 200,000 years ago.” And, he added, “there are an awful lot of cool things that died within the past

200,000 years .”

*This article has been revised to reflect the following correction:*

***Correction: March 20, 2013***

*An article on Tuesday about efforts to revive extinct species misstated the number of years ago that a now-extinct horse lived in the Yukon. It was 70,000 years ago, not 7,000.*