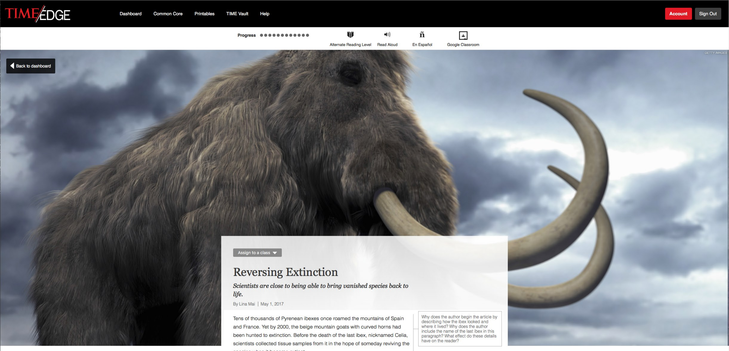


Assign to a class

Reversing Extinction

Scientists are close to being able to bring vanished species back to life.

By Lisa Wei | May 1, 2017

Tens of thousands of Pyrenean ibexes once roamed the mountains of Spain and France. Yet by 2000, the beige mountain goats with curved horns had been hunted to extinction. Before the death of the last ibex, nicknamed Celia, scientists collected tissue samples from it in the hope of someday reviving the species when it became extinct.

Why does the author begin the article by describing how the ibex hunted and where it lived? Why does the author include the name of the last ibex in this paragraph? What effect do these details have on the reader?

Over the next few years, researchers in Spain began the complex process of cloning Celia. In 2002, scientists—led by wildlife veterinarian Alberto Fernández-Arias—inserted Celia's preserved DNA into the egg cells of domestic goats, which had been stripped of their own DNA. After an electric shock, the cells began to divide and form embryos. Scientists then implanted the embryos into goats that were closely related to the Pyrenean ibex. Of 44 implantations, seven females became pregnant, and one gave birth to Celia's clone. Unfortunately, the newborn ibex lived for no more than 10 minutes before its lungs failed. As a result, the Pyrenean ibex has the dubious distinction of being the only species that went extinct twice.

In your own words, describe the sequence of events that led to the ibex. Why does the author write that the Pyrenean ibex "went extinct twice"?

IVAN GLADKIKH—GETTY IMAGES

The Pyrenean ibex, a type of mountain goat, was hunted to extinction. In 2002, scientists used preserved ibex cells to produce a clone. While the clone survived for no more than 10 minutes, its birth proved that de-extinction is possible.

Although short-lived, Celia's double revealed the possibility that similar approaches could bring vanished species back to life. "It spurred the field as a whole and showed that de-extinction is technically possible. It was absolutely inspirational," Helen Pilcher told TIME Edge. She is a cell biologist and the author of the recently published book *Bring Back the King: The New Science of De-extinction.*

Since the Celia experiment, advances in biotechnology have given researchers new insights into reviving species as diverse as the Australian gastric-brooding frog and the massive woolly mammoth. "We're on the verge of being able to do [de-extinction]," says Pilcher. "It's not a fully formed science. It's science in development."

Waking the Dead

In Sydney, Australia, scientist Michael Archer is attempting to bring back a rather peculiar amphibian: the gastric-brooding frog, which was killed off in 1985 by a human-spread fungal disease. The frog had a unique method of reproduction. Female gastric-brooding frogs swallowed their fertilized eggs. "They grew in the stomach until eventually the poor [mother] frog was at risk of bursting apart. It [gave] a little cough and a hiccup, and out come sprays of little frogs," said Archer in a TED Talk.

Why does the author describe the gastric-brooding frog's unique method of reproduction in detail? What effect do these details have on the reader?

Since 2009, Archer's team at the University of New South Wales has worked to bring the frog back, using an advanced technique called somatic cell nuclear transfer. The scientists begin with the egg cell of a closely related species. They then remove the egg's nucleus, or the part of the cell containing DNA, and "inject the … nucleus of the extinct frog into that same egg," Archer told TIME Edge. In 2013, Archer and his colleagues made a major breakthrough. They succeeded in growing embryos containing the extinct frog's DNA.

But then the project hit a snag. The frog embryos survived for only a few days. After some investigation, the scientists determined that there were glitches in their laboratory process to remove the nucleus from the living frog's eggs. But Archer is confident his team will overcome these "speed bumps" on the "way [to] success with de-extinction."

MIKE TYLER

A gastric-brooding frog gives birth through its mouth. The species, which vanished in 1985, had a distinct way of reproducing. Females swallowed their fertilized eggs. They shut down their stomach's ability to produce acid so they could provide a safe environment for their eggs to develop into tadpoles. Eventually, fully-formed baby frogs, known as froglets, crawled out of their mother's mouth.

Archer is passionate about his work. He believes reviving the gastric-brooding frog is necessary, given the rapid loss of the world's biodiversity. Nearly 60% of the world's animal populations have disappeared over the past 40 years, according to a recent study by the World Wildlife Fund (WWF). The report makes the alarming prediction that 67% of vertebrate populations will be lost by 2020.

Archer hopes his efforts to develop the science of de-extinction "[will allow] the loss of biodiversity currently occurring throughout the world." He adds that people have a "moral obligation" to revive species that have become extinct because of human activity.

The Mammophant in the Room

So far, scientists have found some success reviving recently extinct animals. But attempts to bring back long-dead species have been fraught with difficulties. That's because DNA degrades over time, especially when exposed to heat, sunlight, or water. So despite what you might have seen in *Jurassic Park*, you won't see 65 million-year-old dinosaurs anytime soon. But less ancient creatures could one day be restored—especially if their genetic material has been frozen.

Enter the woolly mammoth. These ancient, elephant-like behemoths vanished about 5,000 years ago. The creatures lived in extremely cold regions of the Arctic tundra, which includes northern Alaska, Canada, and Siberia in northern Russia. Recently, climate change has caused the tundra's permafrost to melt and reveal remains of woolly mammoths.

What challenges does George Church face in reviving the woolly mammoth? How is the author using biotechnology to meet those challenges?

While scientists have found several intact carcasses, "mammoth DNA found in the wild is highly fragmented," says George Church, a genetics professor at Harvard Medical School. As the head of Harvard's Woolly Mammoth Revival project, Church is unfazed by this challenge. He is using an extremely precise gene-editing tool, CRISPR (pronounced "crisper"), to splice the mammoth's fragmented DNA into that of a close living relative: the Asian elephant. He is confident his team will produce an embryo within 10 years.

GETTY IMAGES

Scientists at Harvard University are using cutting-edge biotechnology to restore a version of the woolly mammoth, which disappeared about 5,000 years ago. They are combining the mammoth's fragmented DNA with the genetic material of an Asian elephant to create a hybrid animal known as a mammophant.

The result will be not a mammoth clone but rather a hybrid of mammoth and elephant. This creature, known as a mammophant, will look like an elephant. Yet it will sport some mammoth features, like small ears, long shaggy hair, and blood that can tolerate the cold.

Why is Church trying to create a mammophant? How is this de-extinction project different than efforts to bring back the gastric-brooding frog?

Church says the ultimate goal is to release herds of mammophants back to the Arctic tundra. He envisions that his efforts will not only resurrect an extinct species but also help preserve the endangered Asian elephant by giving it traits necessary to survive in the Arctic. "The Asian elephant is endangered because its current habitat overlaps high human population density," says Church. "This could be feasible by making the elephants compatible with the northern regions [in the Arctic tundra that have] low human population."

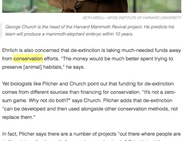
Price of Progress

The genetic technology to restore vanished species is within reach. But some scientists and conservationists say de-extinction could hinder efforts to save endangered animals and protect biodiversity.

What is the author's purpose in these paragraphs? How does the first paragraphs relate to the opening paragraphs?

"[De-extinction is] worse than worthless," says Stanford University biologist Paul Ehrlich. He believes that humanity is "facing a crisis," given the WWF's predictions about the loss of nearly two-thirds of the world's wildlife by 2020. Ehrlich urges scientists to focus on preserving endangered species rather than pursuing the experimental science of de-extinction. "We are rapidly losing biodiversity, and our lives absolutely depend on the other organisms on the planet," he says. "For the next few decades, [de-extinction] can only be a useless or damaging waste of time and resources."

Those in favor of de-extinction, however, argue that the same technologies can be used to save species that are on the brink. "It's also about helping the living and increasing biodiversity," says Pilcher. Scientists can use the same techniques—genome editing, interspecies cloning, genome sequencing—to help endangered species.



BETH WROBLE—WYSS INSTITUTE OF HARVARD UNIVERSITY

George Church is the head of the Harvard Mammoth Revival project. He predicts his team will produce a mammoth-elephant embryo within 10 years.

Ehrlich is also concerned that de-extinction is taking much-needed funds away from conservation efforts. "The money would be much better spent trying to preserve [animal] habitats," he says.

Yet biologists like Pilcher and Church point out that funding for de-extinction comes from different sources than financing for conservation. "It's not a zero-sum game. Why not do both?" says Church. Pilcher adds that de-extinction "can be developed and then used alongside other conservation methods, not replace them."

Why does the author end the article with this quote? Do you think the reporting is objective? Explain. Can a writer be objective? Why or why not? Does a point of view? Why or why not?

In fact, Pilcher says there are a number of projects "out there where people are deliberately collecting cells from endangered animals." Scientists at the University of Georgia's Regenerative Science Center, for example, are building what's being called a "frozen zoo." They extract cells from threatened species and store them in liquid nitrogen. The center hopes to one day use biotechnology to bring these species back to life.

"These kinds of techniques offer these species a lifeline," says Pilcher. "It's not a case of if de-extinction will happen but when."

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