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THBT we should bring back extinct species.

5 Reasons to Bring Back Extinct Animals (And 5 Reasons Not To)

Discover Magazine, By Breanna Draxler, Apr 17, 2020 4:51 PM

Would you like to see a real, live wooly mammoth? Or how about a Tasmanian tiger in the flesh? Scientists have already finagled a few ways to resurrect extinct species from their evolutionary graves. Even muckier than the scientific methods themselves, though, are the social, ethical and legal ramifications of so-called de-extinction.

In *Science* today, two Stanford researchers tackle this tricky topic to parse out exactly what we have to gain and lose from de-extinction technologies. Using the passenger pigeon as a thought experiment, another paper in the same issue looks at the fears and excitement of leaders in the field of genomics.

There are three main ways of bringing back extinct species, according to the Stanford researchers: backbreeding, genetic engineering, and cloning. With backbreeding, scientists use a living species that is genetically similar to the extinct species, and selectively breed it for the traits of the now-extinct species. Genetic engineering depends on existing DNA samples of the extinct species; scientists could bring them back to life by targeting and replacing specific genomic sequences in a closely-related living species. Finally, if viable cell nuclei from the extinct species are available, it can be cloned using a technique called somatic cell nuclear transfer — a tested but as-of-yet unsuccessful method for extinct species.

Based on the current state of the science, the Stanford researchers distill de-extinction down to five pros and five cons:

Benefits of De-Extinction:

- **Scientific knowledge:** De-extinction could offer insights into evolution and natural resources that are currently unavailable to us.
- **Technological advancement:** De-extinction could be a big step forward for genetic engineering.
- **Environmental benefits:** Threatened or damaged ecosystems could be restored with the help of certain now-extinct species.
- **Justice:** If people pushed plant and animals species into extinction, perhaps we owe it to these species to try and bring them back.
- **Wonder:** How cool would it be to see extinct species alive and kicking again?
- Objections to De-Extinction:
- **Animal welfare:** People could be exploiting animals for solely human purposes, and may cause individuals of the de-extinct species harm.
- **Health:** Species could carry retroviruses or pathogens when brought back to life.
- **Environment:** De-extinct species would be alien and potentially invasive; their habitats and food sources have changed, so their roles in these changed ecosystems could be too.
- **Political:** De-extinction may change priorities in other fields of science, such as medical research and the conservation of currently endangered species.
- **Moral:** Is de-extinction playing god, or just plain wrong? It may also have unforeseen consequences.

If an extinct animal were brought back to life in the lab, the authors point out that it would still lack many of a species' key characteristics, such as epigenetics, environment and social groups. Plus it would bring along with it a number of complicated legalities relating to the Endangered Species Act and patent laws. And that doesn't even get into the messy world of if and how such resurrections should be regulated.

In the end, both papers seem to draw open-ended conclusions. But if the practice is really as inevitable as it seems, the authors say the most interesting part will be seeing how humanity reacts.

Bringing back extinct species: If we can, should we?

ASU News, By Sandy Keaton Leander January 02, 2019

Poachers are still making headlines as the demand for rhinos, elephants, tigers and other endangered animals remains strong. Climate change is taking a heavy toll on many animal, insect and plant species around the world. And the human impact on natural habitats including oceans, rainforests and desert lands is worsening.

With troubling news such as this, one might think that animal extinction caused by humans is a more recent phenomenon. But history shows us otherwise. The passenger pigeon, Tasmanian tiger, northern white rhino, Zanzibar leopard and Pyrenean ibex are just a few examples of species that have gone extinct in about the last 100 years because of humans.

The losses of animals like these have spurred some conservationists to do just about anything to save other endangered animals and have inspired researchers to develop technology that might bring back once-extinct species.

In his new book, "The Fall of the Wild: Extinction, De-Extinction, and the Ethics of Conservation," Arizona State University's Ben Minteer looks into the ethical dilemmas of the loss and recovery of animal species.

"A few years ago, I began to notice that my writing about extinction and the wild was becoming preoccupied with the challenge of balancing the pragmatic need for action with a respect for more traditional preservationist values," said Minteer, a professor with the School of Life Sciences and the Arizona Zoological Society Endowed Chair at ASU. "The science editor at Columbia University Press approached me about putting together a little book on the subject. He'd read some of my writing on de-extinction and specimen collection and thought these views could be presented to a broad audience."
In a conversation with Minteer about "The Fall of The Wild," he discussed the ethical issues surrounding the possibility of bringing back extinct species, such as the Tasmanian tiger, as well as the erosion of the wild as a moral ideal.
Question: Around the world, animals, plants and insects are dramatically declining in numbers and may go extinct. In fact, many people believe we are experiencing a sixth mass-extinction event. Some scientists say "de-extinction technology" could be used to bring back extinct species. Yet this would not change human behavior, which likely caused the problem in the first place. Could you discuss?
Answer: Well, as I write in the book, I don't think we would really be bringing back extinct species such as the Tasmanian tiger or the passenger pigeon. We may eventually be able to create facsimiles of these animals through genetic tinkering, but to my mind, they'll be new species, animals de-coupled from the natural history of the original forms. Still, you raise an important point, and it's one of the main themes of "The Fall of the Wild." There's a sense in which these "fixes" elide the hard questions and deeper lessons of extinction, which are more wrapped up in our environmental values and lifestyles than in a technical exercise in gene editing.
Q: In the book, you discuss an "authentic ecological conscience." What do you mean?
A: I borrowed this from the great conservationist-philosopher Aldo Leopold, who observed that moral obligations have no meaning without the compulsion to do the right thing even when no one is looking. It's a quaint expression, but it captures a powerful idea about moral responsibility. Leopold's notion of an ecological conscience serves as a touchstone in my book, helping me understand why, for example, the collection of specimens from newly discovered or re-discovered species may be risky — or why conservation efforts to relocate species in advance of climate change are insufficient if they don't address larger ecological and social maladies.
Q: What about the issue of unintended consequences? There are many examples in science where an invention or new technology was initially wonderful, but then unexpected issues became new problems.
A: It's an anxiety that runs through "The Fall of the Wild," though the unintended consequences I'm most concerned with have to do with our environmental character. Will we be able to maintain respect for a wild nature that we are increasingly manipulating, controlling, even attempting to re-create via genetic engineering? So, the "fall" I'm worried about is really twofold: the loss of wild species and places in the human age, certainly, but also the fading of the wild as an ethical ideal.
"Martha," the last passenger pigeon, expired at the Cincinnati Zoo in 1914. The species is one of the top candidates for de-extinction. ASU Professor Ben Minteer discusses this case in the introduction of his new book.
Q: But what does "wild" mean any longer? Are there any spaces on Earth that are actually untouched by humans and human activity?
A: I think it's a matter of degree. Although it's true that the human fingerprint is visible even in the most remote corners of the planet as a result of anthropogenic climate change, many places and animal populations remain largely uncontrolled and therefore wild in the traditional sense. And of course, wildness can also be found closer to home, including in the midst of cities and subdivisions. Even Leopold, one of our greatest champions of the wild, understood that it was a relative idea, a quality you could find at the edge of a cornfield if you looked closely enough.
Q: What is going right with conservation? If one reads regularly about conservation, the news is grim. Are there positive changes happening that we can look to for hope and optimism?
A: Plenty of things are going right! And success stories are everywhere, from endangered species pulled back from the brink, to river restoration projects, to ranchers and conservationists working together to mitigate rural sprawl. It's important to be aware of the challenges, but we also need those stories of hope. I always like to remind my students that you don't have to take on everything at once — that's impossible! Find a conservation issue or concern that matters to you, learn all you can about it, and then see how you might make a difference.
Q: You talk in the book about the techno-environmentalist Stewart Brand's idea that "We are as gods and we have to get good at it." You respond with a call for "an ethic of collective self-control and ecological restraint." Could you expand on this idea?
A: Brand and I see this very differently. He's pushing us to use our technological acumen to revive extinct species and take hold of the ecological and evolutionary reins, to unleash our power for environmental ends. I'm deeply concerned about that power and wary of spurring it even harder, especially in nature conservation. As I write in the book, I think true power resides not in greater control of nature, but in acts of forbearance, especially when our interventions may undermine other environmental values that we care about. I have great respect for Brand, but I just think he's wrong about this.
Q: What are the two or three main takeaways from "The Fall of the Wild"?
A: Our efforts to conserve, recover and restore species are rightly celebrated as some of the best episodes in our environmental history. At the same time, we've shown that we're capable of going too far in these efforts, especially when the siren call of new technologies and the urgency of global threats such as climate change start to grip us. My book is an attempt to push back against those impulses and remind us of the fallout of these more aggressive pursuits on our environmental ethics.
Q: In the past few years, you've published multiple books and articles related to conservation, extinction, the wild, zoos

and more. Since you've become the Arizona Zoological Society Endowed Chair, what are some of the things you've learned? And what's next?

A: Too many things to list that I've learned along the way — and always more to understand. But the vantage point of the chair position has allowed me to get a better handle on the complexities of animal conservation and a clearer view of how it works across institutions.

I'm starting a new project that explores the idea of the wild in zoos and wildlife parks, what it means and how we might enhance it. The book will be a collaborative effort with the distinguished biologist Harry Greene, a good friend and also a sparring partner for many of the issues I tackle in the book. Harry and I probably agree about 90 percent of the time on conservation questions, but de-extinction is definitely part of the other 10 percent! I'm excited about this one.

Bringing extinct species back from the dead could hurt—not help—conservation efforts

New analysis shows that the money used to care for resurrected animals could be better spent saving living ones

Science Magazine, By David Shultz 27 Feb 2017

Ten days ago, science news media outlets around the world reported that a Harvard University–led team was on the verge of resurrecting the wooly mammoth. Although many articles oversold the findings, the concept of de-extinction—bringing extinct animals back to life through genetic engineering—is beginning to move from the realm of science fiction to reality. Now, a new analysis of the economics suggests that our limited conservation funding would be better spent elsewhere.

"The conversation thus far has been focused on whether or not we can do this. Now, we are progressing toward the: 'Holy crap, we can—so should we?' phase," says Douglas McCauley, an ecologist at University of California, Santa Barbara, who was not involved in the study. "It is like we've just about put the last stiches in [Frankenstein's monster], and there is this moment of pause as we consider whether it is actually a good idea to flip the switch and electrify the thing to life."

To estimate how much it would cost to sustain a population of de-extincted animals, researchers used databases from New South Wales, Australia, and New Zealand that methodically track the cost of conserving endangered, but still living, species. This allowed the scientists to extrapolate the cost of preserving resurrected animals that are similar to living analogs. The cost of caring for a population of resurrected mammoths, for instance, should be similar to the cost of caring for the endangered Asian elephant. The approach completely ignores the large up-front cost of developing and using the genetic and biological technologies to actually resurrect the species. So it underestimates the actual cost of de-extinction programs, the authors say. Even so, the results look grim.

The team considered two different scenarios: one in which the government assumes responsibility for the conservation of resurrected species, and another where private companies sponsor the project. In the first scenario, the money needed to maintain the population of resurrected animals comes directly out of the government's conservation budget, meaning all existing conservation efforts lose some funding. The result, the team calculates, would be an overall loss of biodiversity—roughly two species would go extinct for every one that could be revived. In the second scenario, where the costs are absorbed by private interests and don't detract from the already limited conservation budget, the researchers calculate that we could see a small uptick in biodiversity, especially for animals for which the necessary conservation tools and techniques are already being used to conserve existing endangered species. Reviving the Forbes' snipe (Coenocorypha chathamica), a long-billed bird native to New Zealand that went extinct sometime around the 19th century, for example, would create a net biodiversity gain in New Zealand because many of the conservation practices needed by the snipe are already being carried out for other species living on its former habitat of Chatham Island.

However, the results also show that if instead of focusing the money on de-extinction, one allocated it into existing conservation programs for living species, we would see a much bigger increase in biodiversity—roughly two to eight times more species saved. In other words, the money would be better spent elsewhere to prevent existing species from going extinct in the first place, the team reports today in Nature Ecology and Evolution.

There's always the chance that a wealthy individual or company will get excited by the charisma of de-extinction and choose to fund such a project. If this money would otherwise not have gone to conservation programs of any type, then it would represent a small win for the planet's biodiversity, the authors say.

"If that billionaire is only interested in bringing back a species from the dead, power to him or her," says first author Joseph Bennett, a biologist at Carleton University in Ottawa. "However, if that billionaire is couching it in terms of it being a biodiversity conservation, then that's disingenuous. There are plenty of species out there on the verge of extinction now that could be saved with the same resources."

For McCauley, who recently published a set of guidelines for selecting de-extinction species that would do the most good for the ecosystem, the new research is sobering. "The dominant message in this analysis appears to be that doing de-extinction en masse would be counterproductive," he says. "If this is ethically messy, ecologically awkward, and now also really expensive—I'm out."

Conceptually, de-extinction is certainly still cool. But as a conservation tool in a world of shoestring budgets, Bennett sums up the paper's findings succinctly: "It's better to spend the money on the living than the dead."

Can Bringing Back Mammoths Help Stop Climate Change?

Scientists say creating hybrids of the extinct beasts could fix the Arctic tundra and stop greenhouse gas emissions

Smithsonian **By Paul Mann** May 14, 2018

If you managed to time travel back to Ice-Age Europe, you might be forgiven for thinking you had instead crash-landed in some desolate part of the African savannah. But the chilly temperatures and the presence of six-ton shaggy beasts with extremely long tusks would confirm you really were in the Pleistocene epoch, otherwise known as the Ice Age. You'd be visiting the mammoth steppe, an environment that stretched from Spain across Eurasia and the Bering Strait to Canada. It was covered in grass, largely devoid of trees and populated by bison, reindeer, tigers and the eponymous "woolly" mammoth.

Unfortunately, both mammoth and most of the mammoth steppe ecosystem today have long but disappeared. But a group of geneticists from Harvard are hoping to change this by cloning living elephant cells that contain a small component of synthesised mammoth DNA. They claim that reintroducing such mammoth-like creatures to Arctic tundra environments could help stop the release of greenhouse gases from the ground and reduce future emissions as temperatures rise due to climate change. While this might sound like a far-fetched idea, scientists have actually been experimenting with something similar for over 20 years.

Arctic lands are covered by areas of ground known as permafrost that have been frozen since the Pleistocene. Permafrost contains vast amounts of carbon from dead plant life that is locked away by the extremely cold temperatures. The amount of carbon in these frozen stores is estimated to be about twice as much as that currently in the atmosphere. If it thaws out, microbes will break down soil organic material to release carbon dioxide and methane into the atmosphere.

As a result, permafrost and the associated carbon pools have been likened to "sleeping giants" in our climate system: If they wake up, the resulting greenhouse gas emissions would raise global temperatures even further than currently projected, causing even greater global climate change (a process known as positive feedback).

This is where our shaggy friends may come in. Mammoths and other large herbivores of the Pleistocene continually trampled mosses and shrubs, uprooting trees and disturbing the landscape. In this way, they inadvertently acted as natural geoengineers, maintaining highly productive steppe landscapes full of grasses, herbs and no trees.

Bringing mammoth-like creatures back to the tundra could, in theory, help recreate the steppe ecosystem more widely. Because grass absorbs less sunlight than trees, this would cause the ground to absorb less heat and in turn keep the carbon pools and their greenhouse gases on ice for longer. Large numbers of the animals would also trample snow cover, stopping it from acting like insulation for the ground and allowing the permafrost to feel the effects of the bitter Arctic winters. Again, this would, in theory, keep the ground colder for longer.

This form of mammoth de-extinction and reintroduction could therefore promote grasslands and simultaneously slow the thawing of these frozen soils. So surely it's worth it?

Pleistocene Park is an epic experiment in the Siberian Arctic that has been underway since 1996 and focused on investigating these processes. It is this park to which the Harvard team hope to deliver the first resurrected mammoth hybrid within the next decade.

Founded by Russian geophysicist Sergei Zimov, the 16 square-kilometer park is filled with around 100 animals roaming free including bison, musk ox, moose, yaks, horses and reindeer. The park is designed to determine if the animals can disturb and fertilize the current ecosystem where little grows into highly productive pastures, as well as slowing or even reversing permafrost thaw.

I've been privileged to have visited the park a number of times, and have been amazed at the effort required to undertake such "big science" in this wilderness. We travelled for many hours along the massive Kolyma River to collect reindeer from the Arctic coast, and transported them by small boats to the park – no mean feat in these regions. Adding just another few animals to the experiment was exhausting. But it was totally exhilarating and made me question whether this was such a crazy idea after all.

The limited financial and personnel available to the park has made building and monitoring the project's success difficult. Early evidence with extant species such as musk ox, reindeer and horse suggests animal presence is changing the park landscape structure and cooling the ground.

Recently, the park's grasslands have been shown to reflect more sunlight than the surrounding larch forest, which will reduce the heat penetrating the ground. Scientists have also taken 300 meter-long ground samples from across the landscape to measure the carbon storage in the park, and work out if it differs from that of the surrounding, non-disturbed landscape.

Much of the work relies on public crowdfunding and the park is now seeking money to fill the park with temperature sensors and light sensors. It has already installed a 35-meter high flux tower that continually monitors methane, carbon dioxide and temperature in the park's atmosphere. Collecting convincing evidence to back up the theory clearly takes time and huge effort,

but we should know soon if this bold plan could make a realistic solution to climate change.
Some scientists and conservationists have questioned whether resurrecting the mammoth is really worth it, comparing the high costs with the relative lack of funding for saving the world's elephants. A key question is whether we need mammoth specifically to make these projects work. Could we not simply knock down trees manually, and then use existing animals? I guess this may depend on whether we decide to expand such an approach across far greater swathes of the Arctic, where human intervention will be costly or even near impossible in places.
Yet tackling global climate change needs ambitious, novel and often epic solutions, both to reduce emissions and to minimize the chance positive feedback from the Arctic that may cause untold damage to our climate system. I don't know if bringing the mammoth back is the right approach, but at the moment we lack a decent solution for keeping the giant Arctic carbon deposits in the ground.

Scientists say they are close to resurrecting a lost species. Is the age of de-extinction upon us?

CNN, By Katie Hunt January 16, 2025
Advances in genetic engineering and synthetic biology are making resurrecting animals once lost to this world a tangible prospect. The organizations and companies at the forefront of de-extinction efforts are promising success — and surprisingly soon.
Those efforts just got a boost. Colossal Biosciences, the biotech company behind plans to revive the woolly mammoth, dodo and Tasmanian tiger, announced Wednesday it has raised an additional $200 million in investment, bringing its total funding to $435 million. That hefty sum grew from an initial $15 million in 2021 when entrepreneur Ben Lamm and Harvard University geneticist George Church founded the Dallas-based company.
Within a decade or less, the world may see approximations of creatures only known from black-and-white photographs, taxidermy museum exhibits, and fossilized skeletons, with the ultimate goal of restoring the fauna to their natural habitat.
Advocates say resurrecting extinct animals is attracting new investors with deep pockets to conservation. The scientific field pushes the boundaries of biotechnology in a way that will make it possible to save other species on the brink and offers a promising way to better protect and preserve present-day ecosystems, ultimately making them more resilient to the climate crisis.
Skeptics, however, argue the efforts are an underscrutinized pet project of millionaires, whose money could be spent more effectively elsewhere. Detractors also assert that scientists will only ever be able to engineer unsatisfactory imitations of extinct animals. Raising and breeding such creatures, some experts warn, could imperil living animals used as surrogates and the ecosystems into which resurrected individuals might ultimately be released.
"Who doesn't want to see a dodo? Good God, I do. A mammoth. I mean, wow, amazing," said Melanie Challenger, the deputy co-chair of the Nuffield Council on Bioethics in the United Kingdom.
Challenger, who is the author of "How To Be Animal: A New History of What it Means To Be Human," argues that de-extinction is a fundamentally misleading term. "It's not de-extinction, it's genetically engineering a novel organism to fulfill the functions, theoretically, of an extant (living) organism. You're not bringing anything back from the dead," she said. "And all the way through the process, there are different, quite gnarly ethical considerations."
Is de-extinction really possible?
Scientists are pioneering and refining three techniques in their attempts to revive lost and rare species: cloning, genetic engineering, and traditional back breeding, a form of selective breeding that seeks to recreate lost traits from extinct species.
From this resurrection tool kit, cloning has the capability to create an animal that's almost genetically identical. Dolly the Sheep became the first cloned mammal almost 30 years ago, and recently scientists successfully cloned the endangered black-footed ferret. But the process has been hit-and-miss, and it's unlikely to be useful in attempts to revive animals that disappeared a long time ago.
Netherlands-based Grazelands Rewilding breeds a modern-day equivalent of the aurochs, an ox that features in prehistoric cave paintings. The giant animal disappeared from the wild in the 17th century. Aiming to restore wild landscapes in Europe, the group uses old-fashioned breeding methods, combined with some genetic knowledge, to identify the aurochs' traits in living descendants: domesticated cattle.
Now on the seventh generation, the tauros cattle, as they have been named, are more than 99% genetically similar to the extinct aurochs, said Ronald Goderie, the project's managing director. The animals display physical changes, such as a darker coat color, and behavioral changes, such as how they respond to predators like wolves, over time.
The scientists at Colossal are behind the most ambitious projects. This team wants to resurrect the mammoth, the flightless dodo and Tasmanian tiger, an Australian marsupial that went extinct in 1936. Colossal plans to recreate these creatures by editing the genome of the extinct animal's closest living relative to make a hybrid animal that would be visually indistinguishable from its extinct forerunner. For the mammoth, that animal is the Asian elephant.
High-profile investors in the endeavor include "Lord of the Rings" director Peter Jackson, socialite Paris Hilton, former professional football player Tom Brady and professional golfer Tiger Woods; as well as investment firms such as Breyer Capital. The latest infusion of cash comes from TWG Global, the investment vehicle of Mark Walter, controlling owner of the Los Angeles Dodgers baseball team and a co-owner of Chelsea Football Club in the UK.

How close are scientists to reviving lost species?
With the influx of capital, Lamm said the Colossal team may add another extinct animal to the to-do list as it makes headway in its three flagship projects.
Recent milestones include creating the first induced pluripotent stem cells, or iPSCs, for Asian elephants. This special type of cell can be engineered in the lab to grow into any kind of elephant cell. It's an important tool as researchers model, test and refine the scores of genetic changes they need to make to give an Asian elephant the traits of a mammoth needed for survival in a cold climate.
For the Tasmanian tiger or thylacine, Lamm said the pace of progress has been quicker than expected. Colossal scientists have been able to make 300 genetic edits into a cell line of a fat-tailed dunnart, which is the marsupial that Colossal has chosen as its base species and future surrogate. The company has sequenced what Lamm described as the highest-quality ancient genome to date for any animal.
The dodo is proving most challenging, Lamm said. Colossal has established a flock of Nicobar pigeons, the dodo's closest living relative, which will act as donors for primordial germ cells that will be genetically edited to have dodo characteristics.
However, many of the developments have not been published in scientific journals, meaning they can't be scrutinized by other scientists as is typical during the peer-review process and won't become publicly available for the benefit of the research community.
Lamm said Colossal's mission as a business is not to publish scientific papers, which is a monthslong, if not yearslong, process. However, he said that a paper on the creation of elephant iPSCs is in peer review. The company's academic partners are planning to submit their work to journals, including the thylacine genome, in time, he added.
Colossal has recruited respected high-profile scientists, and many other experts act in advisory roles, including some initially skeptical of some of the company's goals. They include molecular paleobiologist Beth Shapiro, Colossal's chief science officer, who is currently on a leave of absence from her role as professor of ecology and evolutionary biology at the University of California Santa Cruz.
Shapiro is clear that de-extinction is not a solution to the extinction crisis, but she believes that the biotech tools she and her teams develop along the way can be applied more widely to protect and restore endangered species and ecosystems.
"To be clear getting something that is 100% identical behaviorally, physiologically, genetically to a mammoth isn't possible," she told CNN in October. "Once a species is lost, it's gone, and we need to be investing in making sure that things don't become extinct."
Colossal is increasingly using its deep pockets to fund conservation efforts including work to save the world's most endangered rhino species: the northern white rhino. The company is also collaborating on the development of a vaccine for a herpes-like disease that can kill elephants. And Colossal has entered into a partnership with the conservation organization Re:wild to use biotechnology in its projects.
Colossal's stated end goal for its mammoth project is a world where the elephant-mammoth hybrids lumber through the Arctic permafrost compressing the snow and grass that insulates the ground, slowing down permafrost thaw and the release of carbon contained in this fragile ecosystem.
It's "absurd" to imagine herds of cold-adapted elephants making a significant impact on a region that's warming faster than anywhere else in the world in the time frame necessary to make a difference in the climate crisis, said Christopher Preston, a professor of environmental philosophy at the University of Montana.
Nevertheless, restoring lost species to fragile ecosystems has merit as a concept, added Preston, who is also author of "Tenacious Beasts: Wildlife Recoveries That Change How We Think About Animals." He said he was impressed by Grazelands Rewilding's tauros project, which he visited in the course of his work. The grazing habits of the hundreds of tauros cattle, herds of which also now live in parts of Spain, Czech Republic, Croatia and Romania, play a role in recreating an open landscape where other species can thrive.
However, Clare Palmer, a professor of philosophy at Texas A&M University who specializes in animal and environmental ethics, noted that ecosystems are changing rapidly. She said bringing back animals may not work if the landscape is no longer the same.
"We also don't have good knowledge of the welfare needs of members of extinct species and the offspring, for instance, would not be taught by their parents how to hunt, or forage, or relate to other species members," Palmer said.

How extinct animals could be brought back from the dead

BBC News, By Jasmin Fox-Skelly, 15 January 2023

From an Australian frog that swallowed its own eggs to woolly mammoths, scientists are getting ever closer to being able to bring long-lost species back from the dead.
Millions of years ago thylacines, also known as Tasmanian tigers, were widespread across Australia. About the size of an American coyote, these dog-like creatures with stripes disappeared from the mainland around 2,000 years ago. They remained in Tasmania until the 1920s, when they were slaughtered by European colonisers who saw them as a threat to livestock.
"It was a human-driven extinction – European settlers came to Australia and brutally obliterated this animal," says Andrew Pask, a geneticist at the University of Melbourne.
Pask is leading a team of scientists who, together with "de-extinction" company Colossal Biosciences, aim to recreate the wolf-like creature and bring it back.

Thanks to recent advances in genetics, namely the advent of gene editing technology Crispr-Cas9, the thylacine is not the only lost species that we could soon see again. How does the science of de-extinction work, and what kinds of ethical questions does it raise?

In the case of the thylacine, the first step is sequencing the extinct animal's DNA – the genetic blueprint contained in every single cell of the body. Pask did this in 2017.

"The great thing about the thylacine, is that as it was such an important marsupial every major museum wanted one in their collection, so there are hundreds of samples around the globe, and some are exceptionally preserved," says Pask.

"Our sample was a baby taken from its mothers' pouch. They shot the mum and immediately dropped the baby into alcohol, which preserves DNA. That was the miracle specimen and the holy grail for us in terms of being able to really build that genome."

Although it's in pretty good condition, the DNA isn't completely whole. Over time, exposure to UV light and the action of bacteria break down DNA into short fragments. The older the sample, the smaller the fragments that are left behind, until eventually there isn't enough left (there's no chance of bringing back a dinosaur, for this reason).

This leaves scientists with the seemingly impossible task of working out how the various bits of DNA fit together – a task comparable to completing an enormous jigsaw without the helpful picture on the front of the box.

Luckily, a small mouse-sized marsupial called a dunnart was able to provide a blueprint.

"We found the closest living relative to the thylacine, which was the dunnart," says Pask.

Dunnarts and thylacines share 95% of their DNA, which is thought to be highly conserved, meaning it hasn't changed much over time.

Nobody's done it on this scale before because the DNA-editing technology wasn't good enough or quick enough – Andrew Pask

"We sequenced the dunnart's genome and compared that genetic code to our extinct species, we then overlapped them and found everywhere where it was different," says Pask.

However, knowing an animal's DNA is simply not enough to bring it back. The next stage of the puzzle involves tweaking the genes of the dunnart so that they match the thylacine's. This can be done with Crispr-Cas9, the Nobel Prize-winning genome editing method.

"We start with living cells from the dunnart, and we begin to edit all of those changes, so we essentially engineer or turn that dunnart cell into a living thylacine cell with thylacine chromosomes in it," says Pask.

Previously, gene editing wasn't advanced enough to be able to change all of the differing sequences to thylacine DNA in one go. With millions of edits needed, it was assumed that researchers would need to prioritise the most important DNA sequences, yielding an animal genome that wasn't exactly the same as the extinct one. Pask believes this will no longer be necessary.

"All of those technologies are in place, but nobody's done it on this scale before because the DNA-editing technology wasn't good enough or quick enough. But now it's come such a long way that we do have that tech, and we have had significant investment to try and make this work."

Once the researchers have a thylacine cell, they still need to turn it into a developing embryo, and then implant it into a living close-relative's womb. If that sounds easy, then it isn't. "We have a lot of work to do," says Pask.

"We've already made marsupial stem cells which took us about five years. We're now putting those stem cells into embryos to see if we can get them to develop into a whole living animal."

What is Crispr?

Crispr-Cas9 was developed by the Nobel-prize winning scientists Emmanuelle Charpentier and Jennifer A Doudna in 2012.

The technology harnesses a set of genetic scissors that are part of a defence mechanism used by bacteria. When they encounter a potential viral threat, they copy and paste some of the attacker's DNA into their own genome to create genetic scissors that only slip that exact sequence. Its invention has transformed the speed and cost of edting genes, allowing scientists to accurately delete sections of DNA and create cuts where they can insert new genes.

It isn't just the thylacine that could be brought back this way. Preserved scraps of woolly mammoth DNA found frozen in Arctic tundra mean that this large mammal could return. Most woolly mammoths died out roughly 10,000 years ago.

Scientists at Colossal Laboratories and Bioscience – cofounded by researchers from Harvard University – are using Crispr to splice bits of mammoth DNA into the genome of the Asian elephant, the mammoth's closest living relative. The resulting hybrid, known as a "mammophant"', would be adapted to the cold Siberian tundra, and could help fill an ecological void left by the mammoth when they went extinct.

There are, however, limitations with the technology, and obstacles that still need to be overcome.

"Many attributes that we have as living animals require several different copies of genes, but it's not easy to tell from looking at a reconstructed genome how many are needed," says Michael Archer, a palaeontologist at the University of New South Wales in Sydney, Australia.

"You keep your fingers crossed that one copy will be sufficient to enable the feature you're looking for, but there's a big suck-it-and-see component to these projects."

However, genome reconstruction is not the only method scientists could use to resurrect extinct animals.

The aurochs, a type of prehistoric cow, is the subject of ancient cave paintings around the globe. It once roamed the plains of Europe and stood as tall as an elephant. It became extinct in the 1600s. Although long gone, auroch genes can still be found in various breeds of cattle around the continent, with descendants in Spain, Portugal, Italy and the Balkans. Geneticists are now

"back breeding" these species together to produce offspring closer to the qualities of an auroch.
Another idea is to essentially clone the dead animal by taking the nucleus from an intact cell, and then transferring it into the egg of a close living relative in the hope that an embryo will form.
We did it many hundreds of times and it didn't work, and then suddenly one of them did and we saw this hybrid embryo start to divide under the microscope – Michael Archer
The caveat is that you need a complete cell to do this, and cells quickly break down after death. An animal like the thylacine that died out almost a hundred years ago simply couldn't be brought back this way.
But it could be an option for recently extinct species.
In 2003, researchers successfully cloned a Pyrenean ibex, a type of goat that went extinct when the last living individual was killed by a falling tree. Sadly, the new-born died of a lung defect shortly after birth.
Archer is currently using a variation of cloning technology to bring back the southern gastric-brooding frog, a species native to Queensland, which became extinct in 1983. The creature had a bizarre method of reproduction, swallowing its fertilised eggs and using its stomach as a sort of womb.
In 2013, he completed the first step – transferring the nucleus from a frozen frog cell into the empty egg of a closely related amphibian. Incredibly the cells started dividing, and an embryo was formed.
"We did it many hundreds of times and it didn't work, and then suddenly one of them did and we saw this hybrid embryo start to divide under the microscope and it was very exciting," says Archer.
After this initial excitement, however, the project stumbled when none of the embryos developed into tadpoles or frogs.
"The frog embryos developed into a ball of cells, which is normal embryonic development, but then they stopped," says Archer.
"Normally the outside layer of cells folds in and you get a two-layered structure which leads to a tadpole, but ours didn't do that."
The same thing happened when the team tried to create an embryo with two living species of frogs, suggesting that it was an aspect of their experimental work that was interfering with the development of the embryo, rather than a problem with the extinct frog's DNA.
"We're working to find out what this obstacle is in living frogs before we can go back to the extinct animal's DNA," says Archer.
Are we playing God?
Even if we can bring back extinct animals, there are ethical considerations.
Reintroducing mammoths and thylacines might upset existing ecosystems. Since these animals became extinct, others will have evolved and adapted to fill their place. Will these organisms suffer as a result?
Thanks to climate change, the environments these creatures once lived in may have changed drastically. Some of the plants woolly mammoths fed on are long gone as well. Would mammoths still be able to survive on their own in the wild, and if not, who would look after them? Would they just end up as curiosities in a zoo?
"I don't think we should bring all animals back. I think it should have to fit certain criteria," says Pask.
"For the thylacine it's a recent extinction event, so its habitat in Tasmania still exists, all the food it used to eat still exists, so there's somewhere for them to go and they can thrive again in that environment.
"This animal also played a critical role in the ecosystem. It was an apex predator so it sat right at the top of the food chain. There are no other marsupial apex predators so when it was made extinct it left a massive gap."
Some researchers argue that efforts to bring back long-gone species could detract from conservation efforts to save existing animals and even increase the risk of biodiversity loss, and that people may be less incentivised to stop eating meat and destroying habitats.
But de-extinction technology could be used to save living species on the brink of extinction, especially those with an extremely small gene pool, like the white rhino.
I think the ethical issue here was the impropriety of humans making these animals extinct in the first place - Michael Archer
Black headed ferrets are one of North America's most endangered animals – every ferret alive today can trace its ancestry to just seven individuals. Yet researchers at Santiago Zoo in Chile recently took frozen cells from a black footed ferret which died 30 years ago, and used them to create a clone, Elizabeth Ann. Elizabeth's DNA is entirely different, so she can bring a welcome boost of genetic diversity into the population.
"De-extinction tech isn't just about bringing back the thylacine, it's about preventing other animals from becoming extinct," says Pask.
"We have so many bush fires in Australia, and with rising global temperatures we are going to see more adverse weather events in the decades to come. What Australia has been doing is collecting tissues from marsupials in those areas that are most at risk and freezing them. This means that if a bush fire came along, once the vegetation grew back you could repopulate that area with that species."
Archer agrees that the moral rights outweigh any wrongs.
"I think it would be unethical not to do it. I think the ethical issue here was the impropriety of humans making these animals extinct in the first place. It's not about playing God, this is about playing smart human by undoing what we did."