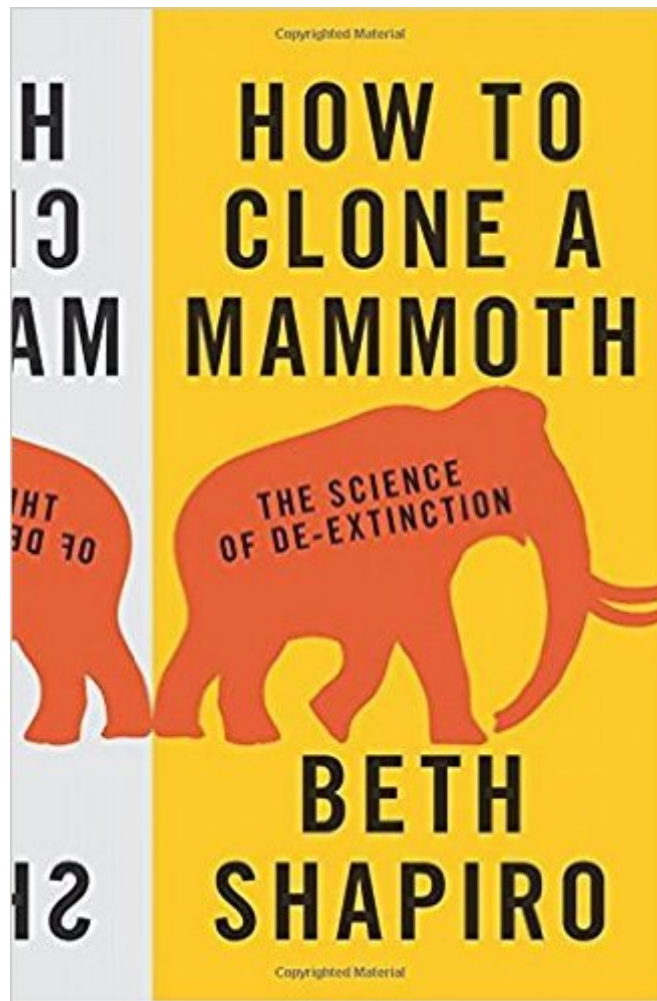


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# How To Clone A Mammoth: The Science Of De-Extinction



## Synopsis

Could extinct species, like mammoths and passenger pigeons, be brought back to life? The science says yes. In *How to Clone a Mammoth*, Beth Shapiro, evolutionary biologist and pioneer in "ancient DNA" research, walks readers through the astonishing and controversial process of de-extinction. From deciding which species should be restored, to sequencing their genomes, to anticipating how revived populations might be overseen in the wild, Shapiro vividly explores the extraordinary cutting-edge science that is being used--today--to resurrect the past. Journeying to far-flung Siberian locales in search of ice age bones and delving into her own research--as well as those of fellow experts such as Svante Paabo, George Church, and Craig Venter--Shapiro considers de-extinction's practical benefits and ethical challenges. Would de-extinction change the way we live? Is this really cloning? What are the costs and risks? And what is the ultimate goal? Using DNA collected from remains as a genetic blueprint, scientists aim to engineer extinct traits--traits that evolved by natural selection over thousands of years--into living organisms. But rather than viewing de-extinction as a way to restore one particular species, Shapiro argues that the overarching goal should be the revitalization and stabilization of contemporary ecosystems. For example, elephants with genes modified to express mammoth traits could expand into the Arctic, re-establishing lost productivity to the tundra ecosystem. Looking at the very real and compelling science behind an idea once seen as science fiction, *How to Clone a Mammoth* demonstrates how de-extinction will redefine conservation's future.

## Book Information

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## Customer Reviews

How to Clone a Mammoth, by Beth Shapiro, is a highly informative look at the possibilities of de-extinction, with particular focus on the titular animal, along with another candidate she is heavily involved in – the passenger pigeon. Thanks to its clarity, focus, and lack of hyperbole, Shapiro's work is highly recommended for anyone interested in this particular topic, and in environmental conservation in general. The book is a true guide to the topic, as Shapiro takes the reader step by step through what the attempt to de-extinct a species would look like. Or actually, several possible attempts, as she explains several potential methods, though she comes down pretty strongly on which is the best and most likely. Her table of contents lays out her basic topics:

- Find a Well-Preserved Specimen
- Create a Clone
- Breed Them Back
- Reconstruct the Genome
- Reconstruct Part of the Genome
- Now Create a Clone
- Make More of Them
- Set them Free
- Should We?

Before she gets to de-extinction, she offers up a fast reminder of when and how mammoths, passenger pigeons, and other species went extinct – naming climate change and human intervention as the two prime causes. She then quickly skims through some modern early attempts/announcements (often poorly reported) on de-extinction attempts and a description of one of her own expeditions into Siberia in search of mammoth DNA. After this introductory material, she moves into seven major questions:

1. Is There a Compelling Reason to Bring This Species Back?
2. Why Did This Species Go Extinct the First Time?
3. Is There a Place for This Species to Live if We Successfully Bring It Back?
4. How Will Introducing This Species Affect the Existing Ecosystem?
5. Will It Be Possible to Learn the Genome Sequence?
6. Is There a Way to Transform the Genome Sequence Into a Living Organism?
7. Will It Be Possible to Move The Resulting Living Organism From Captivity to a Natural Habitat?

Each question is answered in turn through clear, well defined, and mostly easy to follow explanations with no attempt to sugarcoat the many, many obstacles along the way. All science writing should be this crystalline and logical. The only problem area for some might be a few pages when Shapiro gets into some details about genetics involving base pairs, proteins, and the like, though really, a little concentration and some attempt to recall one's old bio class is all that will be needed to follow her explanation. Along with explaining the underlying theory, and then detailing the ongoing work as well as exactly what will be needed in the near future in terms of new tools, greater sequencing capability, etc., Shapiro applies everything in concrete fashion to the task at hand – bringing an actual animal back from the dead – usually the mammoth but at times she discusses as well the passenger pigeon, the dodo, and others. In this way, she never spirals too far afield into theory/abstraction and the reader is always clear on just what her explanations mean in a practical sense. And none of it is done in the breathless sort of fashion that is too often how

popularized science is conveyed. Shapiro makes no promises, never glosses over the difficulties, whether they be problems of finding/extracting material, or creating fine enough genetic tools/manipulators, or simple math (current cloning works at X level of efficiency, gestation periods for elephants are X months, etc.). It is refreshing to have a scientist lay out not just the stunning potential of an idea but also its stunning difficulty. At both the start and the end, Shapiro argues that really the goal here should not be species-focused "not to bring back a real mammoth or a real passenger pigeon" but instead should be on "ecological resurrection" rather than "species resurrection," to restore a balance and a richness to an environment out of whack due to extinction. To this end, then, we needn't worry about recreating a 100% version of the extinct animal, just one that can perform the same environmental duties (say, an elephant modified with enough mammoth genes to be able to thrive in the mammoth tundra steppe environment and do all the good things for the habitat that the mammoth once did). In this vein, along with de-extinction efforts she also spends some time (briefly) discussing re-wilding attempts both those already undertaken (grey wolves in Yellowstone) and more fringe ones (recreating the Pleistocene time period in the US by reintroducing lions, cheetahs, horses, camels, donkeys and other species that have gone extinct here but have living descendants/near-relatives elsewhere). Finally, she closes by addressing, in the briefest section of the book, various concerns about de-extinction, ranging from fears of bringing back a dangerous pathogen (almost certainly impossible she says) to the idea harming current conservation goals (she can see the point but is more optimistic about people). If Shapiro lacks the lyricism of some popularizers of science or nature/environmental writers like Gary Ferguson or Diane Ackerman, she more than makes up for it by a rare ability to make somewhat arcane topics wholly understandable, without dumbing things down or making it all seem so easy or around the corner. *How to Clone a Mammoth* is one of the most logical, clear, concrete, focused, and balanced/realistic explanations of a scientific topic I've read on any topic and is highly recommended.

I'm not a scientist, or a member of academia, but I did enjoy *Jurassic Park*. Dr. Shapiro has produced an accurate picture of where we are, and what we can expect to see in the near future regarding de-extinction. (Some of her predictions were announced by George Church's group at Harvard just last week!) She presents some terribly complicated information, concepts, and challenges in a way that most people can understand. This is not a dry textbook. This is also not a headline-grabbing, breathless prediction of herds of mammoths running amok in Siberia, or skies darkened by thousands of passenger pigeons. It's an honest look at a fascinating subject. What I

found most interesting was Shapiro's thoughtful examination of the ethics of all this. Once we decide we could do this, should we? Should we devote literally piles of money to recreate creatures that may have no place to live? Would this time and money be better spent looking into why some creatures went extinct, while others thrived in the same environment? If you want to learn about de-extinction, buy this book. If you want a read that will entertain you and force you to think, buy this book. And keep your eye on Dr. Shapiro, I guarantee you'll be hearing more from her!

Disclosure: I received this book for free as an advanced reader copy in exchange for an honest review. I loved this book even though it is not really a cookbook about how to clone a mammoth. It is about the scientific, ethical and legal aspects of bringing extinct species back to life. Author Beth Shapiro explains the science in a clear and conversational manner. She also freely expresses her opinions about the subject, but is always clear about what is factual, what is opinion and what is speculation. Shapiro integrates some personal anecdotes into the book and creates a relationship with the reader. When I finished reading the book, I felt I was saying goodbye to a friend I had just met. I strongly recommend this book to anyone interested in science, especially people interested in evolution and genetics.

As a scientist working in this field, Beth Shapiro writes with authority. I was a little worried the science would be over my head, but the book is very accessible. Even more, it's fascinating. This is the type of book that is so thought-provoking and interesting that you press it on friends so that they can read and discuss the ideas and information with you. Definitely recommended.

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