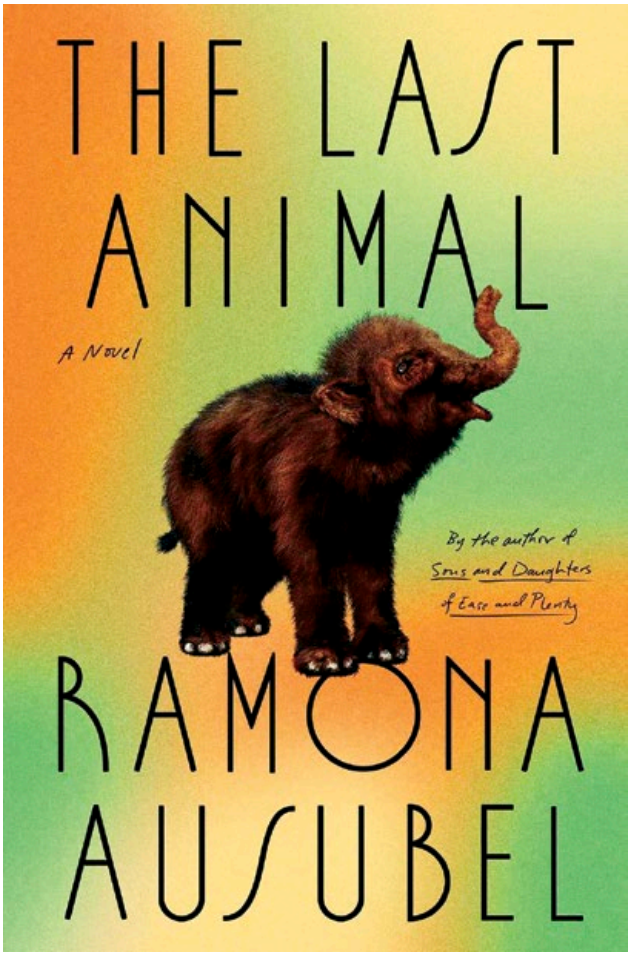
Chasing De-extinction

MARK SCHAEFER

Three decades ago, Michael Crichton's *Jurassic Park* presented readers with the tantalizing question of whether a dinosaur could be brought back to life. Much of his novel is a depiction of the unanticipated consequences of a successful cloning effort—one that would likely be impossible in the real world, considering the difficulty of finding DNA that has remained intact for 65 million years. However, such a scientific challenge might be more manageable for the woolly mammoth, which disappeared from its steppe tundra habitat just 4,000 years ago, and has a close living relative in the Asian elephant. Today, the prospect of revival is no longer fiction: scientists at Colossal Biosciences are hard at work attempting

The Last Animal
by Ramona Ausubel. New York, NY: Riverhead Books, 2023, 288 pp.



to "de-extinct" woolly mammoths.

Colossal's objective is not to actually clone a mammoth, but to edit the genome of the Asian elephant to produce "a cold-resistant elephant with all of the core biological traits of the woolly mammoth," according to the company. Colossal's scientists hypothesize that reintroducing large herbivores to the Siberian and North American tundra would promote the regeneration of grassland, reducing permafrost thaw and the emission of climate-warming greenhouse gases.

In her novel *The Last Animal*, Ramona Ausubel builds on the science and technology employed in this and related de-extinction efforts to take readers on an action-packed, globetrotting quest to resurrect a woolly mammoth. The best fiction not only entertains, it encourages readers to imagine, ask questions, and examine the world from a fresh perspective. *The Last Animal* certainly succeeds in this regard. It is not a work of science fiction, but a carefully wrought story at the juncture of fiction and science, transporting readers to the frozen tundra of Siberia, to the otherworldly perimeter of an Icelandic fjord, and ultimately to the sunny shore of Italy's Lake Como and the mountains beyond. The engaging adventure raises possibilities and invites questions, and in doing so touches on a host of societal considerations, including two of the most intractable issues at the intersection of environmental and science policy: climate change and the rapid decline of biodiversity. The story also illustrates persistent problems within the scientific enterprise itself.

Jane, a recently widowed graduate student in paleobiology, travels to Siberia accompanied by her two teenage daughters, Eve and Vera, in search of a mammoth frozen in ice, the source of genetic information for a de-extinction project. As a single mother, Jane struggles with the challenges of raising children and completing her studies, while the family grapples with the recent death of the girls' father. The research effort is led by a demanding professor who is skeptical of Jane's abilities and commitment, in part because of her dedication to her daughters.

The Last Animal is a page-turning mother-daughter quest to achieve and be recognized. Their challenge is to resurrect an extinct animal—while grieving a profound human loss they cannot reverse. Jane's daughters are curious, witty, world-weary, enterprising, and mostly supportive of their mother's pursuit of her dreams. Written primarily from the point of view of Vera, Jane's youngest child, the book provides a glimpse of the world from the earnest perspective of a teenager alarmed by the deterioration of the global environment and determined to find a way to contribute to changing the course.

Taking place amid what many experts have called the planet's sixth mass extinction, the story is a reminder that this would be the first mass extinction caused by human activity. In the novel, Eve laments the rapid decline of biodiversity and poses a blunt question: "We have moved into every habitable corner and demolished everything. We want elephant tusks and tiger pelts and mountain lion heads. We're really, really good at

wanting. What if we want to add things for once?"

The prospect of bringing an extinct six-ton keystone species back to life to foster the restoration of an ecosystem raises a host of questions: Is it really a mammoth if it has less than the full complement of genes of the original? Would a resurrected mammoth be capable of producing viable offspring? How would it interact with other species? What size population would be needed to promote a productive ecosystem? Could there be unintended consequences of such a mammoth—even colossal—project?

Some experts believe the prospect of bringing extinct species back to life could lead the public to assume that biodiversity loss can be reversed by de-extinction. Others wonder if these efforts might divert resources from long-standing, proven conservation activities. It is not the task of a novel to answer these kinds of questions, but Ausubel's story provokes consideration of them. From a science and technology policy perspective, it's a fortunate circumstance when a book written for broad public consumption surfaces issues that foster informed discussion and debate. Like other innovations involving genetic engineering, approaches to de-extinction extend beyond scientific research into society, where feasibility and objectivity encounter opinions and values. One of the distinctions of Ausubel's novel is that those opinions and values are expressed by Jane's teenage daughters.

In the mid-1950s, conservationist and author Rachel Carson wrote of the affinity youth have for nature: "A child's world is fresh and new and beautiful, full of wonder and excitement." The child needs the "companionship of at least one adult who can share ... the joy, excitement, and mystery of the world we live in." In *The Last Animal*, Jane is fully dedicated to sharing the wonder and excitement of nature with her daughters. Ausubel is at her best when she offers readers lyrical accounts of their journey—the possibilities, unexpected turns, and discoveries laced with suspense and humor. The reader is brought along on not just a scientific quest, but a dreamy expedition, offering vivid glimpses of what could be. Vera envisions a future Siberia "populated with musk oxen, bison, yak, reindeer, and horses, all of them having made a journey across continents, sometimes seas. And the mammoth would stand there, fur and the pearls of tusks, and her silhouette would look exactly as imagined and as natural as the grass. As if she had been there all along, every year of the tens of thousands, and here still."

The curiosity and sense of the possible displayed by Vera and Eve drive the story forward. Like many young people, they are worried about the world they have inherited. They look to science to guide society. That these youth have active imaginations and envision possibilities that others might see as unrealistic holds hope for the future. In that sense, *The Last Animal* is about the desire of a younger generation to act on their sense of wonder and contribute to conserving the global environment. The girls feel the need to respond, searching for ways to help their mother revive a mammoth. Their efforts illuminate the complexity of such an endeavor.

The Last Animal is also a vivid portrayal of the challenges women face in pursuing careers in the research environment. When her husband was alive, Jane made his scientific career a priority, setting aside many of her own aspirations to raise Eve and Vera. Now, as a student and single mother, her struggles loom larger. Jane's daughters experience firsthand the difficulties their mother confronts in the lab and the field. Vera is fascinated by science, but troubled by her mother's struggle to succeed and gain recognition for her contributions. She laments the thought of her "at her computer transforming herself into a CV, flattened down to information, skill set, honors earned and missed."

Jane's professional challenges are reminiscent of those of chemist Rosalind Franklin, whose contributions to understanding the structure of DNA went unrecognized for years. Eve and Vera are excited about their mother's central contributions to the research program and what will follow, but Jane quells their enthusiasm, telling them, "Even if the lab ... won something, it would be the professor who got the prize. I'd get a steak dinner and an anonymous quote in an article at best." Jane's response is not hyperbole. Recent studies underscore the continuing gender discrepancies in authorship and recognition of contributions. If she were alive today, Franklin might appreciate a novel about two teenagers cheering on their mother, hoping her work would be recognized by the world, but Franklin would also be disappointed that this aspect of the story is still grounded in reality.

Ausubel has not only produced a novel filled with dynamic characters and engaging scenes, she has furthered an important conversation about the precipitous decline of biodiversity, its implications, and ways to respond. And along the way, her story underscores the importance of ensuring the world of science and engineering is a place where all who wonder are welcomed and respected, and all who achieve are recognized.

Mark Schaefer *was an assistant secretary of commerce during the Obama administration. During the Clinton administration he was assistant director for environment in the Office of Science and Technology Policy, and later a deputy assistant secretary of the interior.*