Australian Council of University Art & Design Schools

Designing the Gap in De-extinction

Yuxin Wang, University of Western Australia

Abstract

Contemporary de-extinction projects, most visibly Colossal Biosciences' effort to engineer a woolly mammoth, are widely presented as a technological path to ecological restoration. Yet because ancient DNA is fragmentary and developmental environments cannot be reproduced, no extinct organism can be authentically recovered. This paper argues that de-extinction is better understood as a design practice organised around an irreducible gap between the extinct species imagined by conservation narratives and the organism biotechnology can materially produce. This gap takes two interrelated forms: technological practice, which translates extinct species into editable genetic and phenotypic functions, and narrative practice, which constructs broader meanings of ecological restoration through speculative storytelling and corporate communication. Neither form of design closes the gap; both continually reproduce it. The paper concludes that this repeated failure to close the gap produces a deeper form of objectification, in which not only biological materials but entire species are rendered as designed objects.

Keywords: De-extinction, Species, Design Fiction, Objectification, Biodesign

Introduction

In response to the accelerating anthropogenic biodiversity loss (IPBES, 2019), contemporary conservation increasingly incorporates emerging biotechnologies as active strategies for ecological intervention. Among these, de-extinction has become one of the most ambitious projects, proposing the recreation of extinct species such as the woolly mammoth as a means of restoring ecosystems, mitigating climate change, and repairing historical human impacts. Through scientific publications, corporate manifestos, and popular media, de-extinction is presented not only as a technological innovation but also as a hopeful vision of ecological recovery.

Yet this vision depends upon a fundamental contradiction. Although de-extinction is commonly described as the return of extinct species, contemporary biotechnology cannot authentically reconstruct organisms that have disappeared. Ancient DNA is incomplete, developmental processes cannot be replicated, and species themselves cannot be reduced to stable genetic blueprints (Shapiro, 2015). Consequently, an irreducible gap emerges between the extinct species imagined by conservation narratives and the organism that biotechnology can materially reproduce. Rather than representing a temporary technical obstacle, this gap constitutes the fundamental condition within which de-extinction operates.

It is precisely because of this gap that de-extinction becomes a design practice. Since the original species cannot simply be recovered, scientists must continually make choices such as which genetic traits should be reconstructed, which ecological functions should be prioritised, and ultimately what should count as a resurrected species. At the same time, broader conservation narratives seek to translate these engineered organisms into culturally recognised symbols of ecological restoration and environmental hope.

Therefore, the gap between technology and imagination constitutes a space for design. This design takes two interrelated forms including technological practice and narrative practice, yet neither succeeds in closing the gap; rather, both continually reproduce it, extending living beings to further objectification.

Against this background, this paper asks: in what ways does this gap subject living beings to further objectification? Section one examines how the gap emerges within technological practice, translating extinct species into editable biological functions; section two examines how speculative narratives construct broader meanings of ecological restoration through design fiction and corporate storytelling. Together, these sections argue that de-extinction objectifies animals through technological practice, narrative practice, and ecological justification.

By reframing de-extinction as a design process organised around an irreducible gap, this study contributes to contemporary design discourse by revealing how design actively reshapes concepts of species, conservation, and more-than-human futures.

Design as a way of understanding de-extinction

De-extinction began with a powerful speculative imagination: the resurrection of the woolly mammoth as a specific extinct species capable of returning to its former ecological niche (Colossal Biosciences, n.d.). This vision preceded and motivated the entire technological enterprise. Yet once translated into laboratory practice, researchers are required to make continuous decisions—which genetic sequences should be reconstructed, which phenotypic traits prioritised, and which ecological functions preserved (Shapiro, 2015) rather than recovering an authentic extinct organism. As the project moves from speculative vision to material practice, the central challenge is no longer how to restore the mammoth, but how to determine what should count as a mammoth in the first place.

This gap helps explain why de-extinction becomes a design process. Herbert Simon notably describes design as "devising courses of action aimed at changing existing situations into preferred ones" (Simon, 1969). In de-extinction, the existing situation is the extinction of the mammoth, while the preferred situation is the return of a mammoth-like animal. Because the original mammoth cannot be completely recovered, scientists can only keep moving from the existing situation towards a constructed preferred one. Every decision about genes, traits, or ecological functions becomes part of the design process. Design is therefore not about reaching the goal of creating an original mammoth, but about continuously reducing the distance between imagination and reality.

Auernhammer and Ford (2022) further develop this understanding by arguing that, despite the diversity of design definitions, their shared semantic core lies in purposeful activities such as planning, making, and meaning-making. Similar to Simon, they position design as an intentional practice driven by human agency. Such an understanding inevitably establishes an (anthropocentric) subject–object relationship, in which human actors become the subjects who intervene, while the object of design is continuously shaped through their actions. In the context of de-extinction, the mammoth is therefore no longer treated as a species waiting to be rediscovered, but as an object of design whose genetic composition, phenotypic traits, and ecological functions are actively selected, negotiated, and reconstructed.

The discussion above suggests that design emerges precisely within the gap between the imagined mammoth and the mammoth that biotechnology can materially produce. This also raises another question: where does this gap come from?

This paper argues that it is produced through two interconnected design practice. On the one hand, technological practice establishes what is technically achievable by determining which genes, traits, and ecological functions can be reconstructed. On the other hand, narrative practice constructs what the mammoth is expected to be by shaping its symbolic meanings through conservation discourse, media representation, and corporate visions. These two forms of design do not operate independently. Instead, they continuously interact to define both the technological possibilities and the cultural expectations of de-extinction. The gap is therefore not simply the result of technological limitations, but a design condition jointly produced by imagination and technological practice. It is within this condition that design operates.

To further analyze de-extinction as a design practice, this paper introduces the theory of design fiction (Bleecker,2009; Dunne & Raby, 2013; Lindley & Coulton, 2015), using the relationship between fact and fiction as an analytical tool to examine the interweaving of narrative and technology in de-extinction practice.

Technological practice

The gap in technological practice

The technology of de-extinction rests on a sobering technical premise: completely restoring an extinct species to its former state is virtually impossible. Ancient DNA survives only as short, degraded fragments; the developmental and epigenetic environment in which the organism once lived cannot be reconstructed (Shapiro, 2015). In response to these limitations, Shapiro (2015) advocates a corresponding shift in the object of inquiry: away from the literal resurrecting the species and toward design of organisms capable of performing similar ecological and functional roles. De-extinction, in this reframing, becomes less a project of literal resurrection than one of ecological design—the practice shifts, in effect, from "resurrecting a mammoth" to "how to design a mammoth." Because no stable extinct organism remains to serve as a referent against which "restoration" could be verified, the researchers' choices cease to function as acts of discovery and instead take on the structure Herbert Simon (1969) assigns to design: not the recovery of an existing state, but the devising of a preferred one.

At the heart of this shift is transforming a diffuse, imaginative species issue into a concrete, actionable, and engineerable goal. This is a crucial step in moving extinction from science fiction narrative to laboratory reality—the mammoth is no longer a complete life form waiting to be revived, but a series of design tasks that need to be decided and implemented one by one.

Taking the mammoth project as an example, we can see how this transformation specifically occurs. The initial idea of "resurrecting the mammoth" quickly encountered material limitations. Additionally, scientists cannot obtain a complete genetic and phenotypic evidence of a mammoth. They therefore have to construct an understanding of what is a mammoth is based on partial information (Shapiro, 2015). Then, using an existing animal, in evolutionary proximity, such as an elephant, as a template to be genetically molded and shaped to resemble an imaginary mammoth-like organism (Colossal Biosciences, n.d.).

Due to the severe degradation of ancient DNA, the recoverable fragments are typically only 30 to 90 base pairs long, while the mammoth genome is over four billion base pairs long . As a result, ancient DNA is insufficient to independently constitute a complete "mammoth" genome, and researchers must use extant closely related species as a reference framework (Shapiro, 2015, p. 111). Currently, the Colossal de-extinction project uses the Asian elephant (Elephas maximus) as the gene-editing target, while simultaneously using the African elephant (Loxodonta africana) genome, which has higher genome quality and a more complete assembly, as a reference sequence, and then gradually integrates genetic

fragments from ancient DNA that can represent mammoth characteristics (Colossal Biosciences, n.d.).

Within this process, comparative genomics becomes an important foundation for designing mammoths. Since Asian and African elephants are the closest relatives of mammoths, they provided the basic "skeleton" for the design work (Colossal Biosciences, n.d.). Researchers identified key traits related to cold environments by comparing the differences in ecological adaptation between mammoths and extant elephants, and then gradually added “mammoth features” to the elephant genomic “skeleton” (Shapiro, 2015).

Therefore, the mammoth, living in extremely cold environments, was not restored, but rather the focus was on how an elephant could live in extremely cold regions. Thus, cold-resistance-related characteristics were gradually broken down into a series of designable functional units. These included long, bushy fur, a thick layer of subcutaneous fat for thermoregulation and energy storage, and metabolic and hemoglobin adaptations to support survival in low-temperature environments (Shapiro,2015; Colossal Biosciences, n.d.). Researchers used ancient DNA and comparisons with extant elephant relatives to select candidate genes and then employed gene-editing technologies (such as CRISPR) to introduce these genetic variations into Asian elephant cells, thereby endowing them with corresponding physiological functions (Shapiro, 2015; see also Church et al., as cited in Shapiro, 2015).

The news released by Colossal about mice with long hair provides evidence of the successful testing of candidate genes associated with the long hair trait. Although these experiments are not directly aimed at creating a mammoth, these functional modules are continuously combined and accumulated towards the imagined revival of species (Callaway, 2025). Long hair, the ability to withstand extreme cold, and other such imaginings are gradually redefining "what constitutes a mammoth" in technological practice.

Species as technological fix

De-extinction, then, can be redefined as a technological fix for anthropogenic biodiversity loss: a structural, historical ecological crisis is transformed into a problem solvable through engineering. Colossal itself frames the project in exactly these terms, defining "functional de-extinction" as "the process of generating an organism that both resembles and is genetically similar to an extinct species" (Colossal Biosciences, n.d.).

However, even if to adopt this techno-fix narrative ,the aim to "successfully design a mammoth" remains a thorny issue. Organisms not only need to survive in their environments, but they also need to possess the behaviors necessary to perform corresponding ecological functions, such as continuously modifying their habitats. For example, in the case of the woolly mammoth, even if gene editing technology can endow observable phenotypic traits such as thick fur and cold-resistant metabolism, how can we design and reconstruct the ecological environment and biosphere that shaped mammoth behavior?

The ecological and social environment is not merely the external background of a species'

existence, but an important component of the species itself. As Mayr's biological species concept identifies species as reproductive, ecological, and genetic communities simultaneously (as summarized in Ereshefsky, 2022). And an ecological niche is not only the space for a species to live in, but also one of the important conditions for maintaining a species' identity.

However, the Pleistocene tundra ecosystem has long since disappeared (Zimov et al., 2012), and the ecological and social environment on which mammoths learned migration routes, foraging methods, social communication, and group behaviour no longer exists. Behaviors cannot be directly engineered into an organism through molecular editing like gene sequences; rather, they are gradually formed through long-term social learning, ecological practices, and intergenerational transmission (Bates et al., 2025). Therefore, the limitations faced in eradicating extinction are not only due to the technological bottlenecks of genetic engineering itself, but more profoundly due to the irreversible loss of the species' ecological and behavioural history. Even if technology can design genes, edit traits, and optimized functions, how can we restore a lost ecological niche and/or species behaviour? The question to ask is then when scientists aim to resurrect an extinct animal, what exactly are they designing?

Narrative practice

The definition of species

Before responding to the question raised above, the concept of "species" itself must first be addressed, since the definition of species has never been settled. From Aristotle to Linnaeus, classical naturalists treated species as fixed natural kinds defined by essential traits, an essentialist view that presumed an immutable boundary between one species and another. Darwinian evolutionary theory overturned this view, reframing species as dynamic populations shaped by heredity and variation rather than stable essences (Ereshefsky, 2022). Subsequent developments further destabilised fixed species boundaries: biological, phylogenetic, and ecological models variously emphasised reproductive isolation, shared ancestry, or clusters of evolving traits (Zachos, 2016). As philosophers such as John Dupré (1993) have argued, no single definition can capture biological reality; species are plural, contingent, and historically situated. Wilson (1999), however, contends that this instability does not necessitate abandoning realism about species; rather, species can be understood as natural kinds constituted by homeostatic clusters of properties rather than fixed essences.

Therefore, species are not fixed categories, but relational taxonomies shaped by ecological, scientific, and technological practices. The conservation history of the North American red wolf (Canis rufus) offers a concrete example. 20th-century predator eradication programs nearly drove the red wolf to extinction, with surviving individuals hybridising extensively with coyotes. The "purebred" populations established for captive breeding in the 1970s were later shown by genomic studies to already carry substantial coyote ancestry, and some studies suggest the red wolf may never have had an evolutionary history independent of the grey wolf–coyote hybridisation lineage (vonHoldt et al., 2016). Its species status has thus

remained controversial, directly affecting its protection under the U.S. Endangered Species Act (National Academies of Sciences, Engineering, and Medicine, 2019; Persinger & Palmer, 2025). Whether the red wolf is deemed "worthy of protection" depends not on some objective biological fact but on whether the scientific community narrates it as an "independent species" or a "hybrid lineage" at a given historical moment—species boundaries here flow with human-constructed discourses of law and politics.

As the red wolf case illustrates, species boundaries cannot always be clearly defined by genetic differences; similarly, in the mammoth de-extinction project, researchers must determine the extent to which the genomic background of modern elephants is preserved, and the extent to which genetic segments considered "mammoth-like," are introduced, to be sufficient for this newborn individual to be identified as a "mammoth," and not merely an edited modern elephant. Shapiro uses a jigsaw puzzle analogy: the mammoth's DNA fragments are the pieces of a jigsaw puzzle, while the modern elephant genome is like the reference image on the puzzle box (Shapiro, 2015, p. 112). However, this paper argues that this analogy is reductionist and simplistic and does not convey the diversity, messiness and paradoxes involved within the human desire and ambition to taxonomize nature.

However, the reason de-extinction can become a design practice is not precisely because species definitions are inherently unstable, but precisely because species definitions themselves are negotiable. When scientists claim they are "designing an extinct species," a more pressing question arises: what exactly are they designing? In fact, what they design is not merely a set of DNA sequences, but a continuous construction of the material and cultural species category of “mammoth” itself. From the selection of ancient DNA and the reference to the modern elephant genome, to the screening and combination of key traits, every technological decision answered the same question: What kind of life can be called "mammoth"? In other words, the design practice occurred not only at the gene editing level, but also at the species definition level. Technologies and narratives are put together to shape a temporarily stable identity of a "mammoth" that could be recognized by both the scientific community and the public—a large elephant with long hair, adapted to cold environments, and expected to restore tundra ecology and mitigate climate change.

The gap in narrative practice

As discussed above, technological practice responded to the question of what the mammoth could be engineered to look like. Narrative practice, by contrast, not only constructs the definition of the species in cultural terms, but also shapes the motivation and meaning behind reviving it. It is this latter function within Colossal's narrative practice that exaggerates the actual effects of treating the species as a technological fix.

This exaggeration takes the form of a gap between laboratory fact and public narrative. The Woolly Mouse, discussed in the previous section, demonstrates the successful testing of candidate genes for mammoth-like traits (Kluger, 2025). What Colossal made public, however, was the result but not the process; the gene-editing procedure itself, discussed in the first section, remains offstage.

Colossal recently released the Woolly Mouse promotional video to fill this gap. In the short film, this little mouse, edited to have longer fur, lives in a cozy little house adorned with

Christmas lights, celebrating Christmas and bringing seasonal blessings: "From Colossal's laboratory to your wintry nights, happy holidays to all…and to all woolly mice." (Thomas,2025) Here, the fur is no longer merely a technical specification, but rather, like a design element, woven into a grand narrative of a warm daily life. The engineered mouse is presented as a cute domestic pet (rather than a pet pest mouse or alternatively as a wild animal such as a woolly mammoth). This promotional vehicle is neither an illustration nor graphic design or a tool, but rather a living organism. Additionally, the farfetched distance between the living furry little woolly mouse and the grand promise of saving earth is staggering. These are deliberate design decisions made by Colossal.

Just as technological practice substitutes the recovery of an original mammoth with the devising of a preferred organism, narrative practice here substitutes the reporting of a technical fact with the devising of a preferred meaning—the mouse is not described, but designed into a story of seasonal warmth and planetary rescue.

Figure 1: The Woolly Mouse Promotional Video. Copyright 2025 by Colossal Biosciences.

A second, more substantive form of exaggeration operates through the science itself rather than through sentiment. Colossal's public justification for the mammoth project draws heavily on the "mammoth steppe" hypothesis: the claim that Pleistocene megaherbivores through grazing, trampling, and seasonal migration across a grassland ecosystem once stretching from France to Canada actively maintained a high-biomass, carbon-sequestering landscape, and that their disappearance some ten thousand years ago allowed moss and shrub tundra to replace it, reducing plant and animal biomass in the Siberian tundra by roughly a hundredfold (Zimov et al., 2012). Colossal extends this ecological argument into a broader public claim: “The woolly mammoth was a natural custodian of a healthier planet. Bringing the woolly mammoth back means bringing back a better earth” (Colossal Biosciences, n.d.).

Yet this conclusion extends considerably beyond what the underlying ecological hypothesis

can directly demonstrate. The mammoth steppe hypothesis proposes one possible ecological mechanism through which large herbivores may have contributed to maintaining grassland ecosystems (Zimov et al., 2012). In Colossal's public narrative, however, this contingent scientific hypothesis is reformulated into a much broader promise that engineering mammoth-like animals will help restore the Earth itself (Colossal Biosciences, n.d.).

The scale of the claim therefore expands dramatically. A laboratory project concerned with reconstructing selected cold-adaptive traits becomes a planetary narrative about climate repair.

Design fiction as critical lens

Lindley and Coulton (2015) define design fiction by three conditions: it creates a story world, prototypes something within that world, and does so to open a discursive space where "something may mean anything".

Colossal's narrative approach to "bringing back the mammoth" likewise constructs a story world in which technological practice and narrative practice are woven together to produce a compelling future. It bears a notable resemblance to speculative design (Dunne & Raby, 2013): both draw on scientific inference and hypothesis to construct stories that are compelling, or provocative, or both. The crucial difference lies in intent — speculative design tells stories in order to question and critique (Dunne & Raby, 2013), whereas Colossal's narrative tells a story in order to persuade. Design fiction, a design method closely related to speculative design, differs from it in a further respect: while speculative design is often associated with critical reflection on possible futures (Dunne & Raby, 2013), design fiction does not necessarily prescribe either a critical or celebratory position. Its value for this paper lies instead in its ability to analyse how technological facts, prototypes, and fictional futures become intertwined within a shared narrative space.

Bleecker describes Design Fiction as a design practice that operates between fact and fiction. As he writes, "Design fiction happens when you tie together fact and fiction and play comfortably and happily in the between. In between fact and fiction is where designed fictions are most active" (Bleecker, 2009). For Bleecker, Design Fiction is not simply about imagining speculative futures. Rather, it establishes connections between scientific facts and future imaginaries, allowing the two to reinforce one another. It is precisely within this "in-between" space that speculative technologies acquire a sense of plausibility, making imagined futures appear as though they already exist.

However, when we examine extinction through the lens of design fiction theory, the "gap" discussed in this paper diverges from Bleecker's "in-between." Bleecker's in-between names a productive space where fact and fiction remain distinguishable even as they entangle; in the context of Colossal's aim at extinction mitigation, however, fact and fiction become interchangeable rather than merely entangled. For example, an elephant with several edited genes is presented as a mammoth, and this "mammoth" is credited with the capacity to "restore the Earth" (Colossal Biosciences, n.d.).

Hence, fiction is continuously and systematically embedded and emphasized as a fact until the boundary between the two becomes sufficiently blurred.

Colossal's website skillfully weaves fact and fiction together, from its visual design to its organization of information, continuously interlacing the two throughout the entire site (Colossal Biosciences, n.d.). The site as a whole adopts a futuristic, high-tech aesthetic: neon-like, glowing, dazzling colors and cinematic rendering are juxtaposed with genuine portraits of scientists, photographs of furry animals, clean and futuristic-looking laboratories, and technical data. The homepage's full-screen promotional video treats images of animals and laboratories with an almost epic cinematic quality, while the bottom of the page settles firmly back onto Colossal's real, recognizable company logo. Under this visual treatment, speculative imagination and actual scientific research are granted equal credibility.

Figure 2: Colossal Official Website. Copyright 2026 by Colossal Biosciences.

Living diegetic prototype

Bleecker proposed that design fiction is the practice of telling stories about designed objects, with its core tool being the diegetic prototype—a concept originally developed by Kirby (2010) to describe how not yet existing technologies are made to seem naturally existent within a fictional world (Bleecker, 2009). Colossal technologies and their entangled narratives can be seen as a form of design fiction, and the living Woolly Mouse and the fictionalized mammoth are both diegetic examples within it, promising a techno fix for a world on the edge of ecological collapse.

The resurrected dinosaurs in *Jurassic Park* (Spielberg, 1993) are also a kind of diegetic prototype. However, as a prototype, the dinosaur is ultimately a product of special effects, models, and editing; it can be placed arbitrarily into any scene by the creator, experiencing no pain, no aging, and having no physiological needs of its own. Its meaning is entirely conferred by the narrative, and ends when the narrative does.

De-extinction, however, complicates this distinction between fiction and reality. Unlike conventional diegetic prototypes, the technologies and organisms involved in de-extinction are not entirely fictional: they already exist materially in laboratories. Yet the ecological future they promise—such as the restoration of extinct species or the use of these species as a technological fix for ecological collapse—remains speculative. They therefore occupy an ambiguous position between material reality and imagined futures. It is precisely this position that leads me to term them living diegetic prototypes.

Colossal's Woolly Mouse, however, is something else entirely. Like the imagined mammoth, they are designed objects brought into being to construct a de-extinction future. Yet unlike a fictional prototype, they do not cease to exist when the promotional video or press conference ends. They remain living beings whose continued existence is tied to the narrative they are designed to support.

The woolly mouse functions as a living diegetic prototype: its significance lies not in having a life or future of its own, but in demonstrating the possibility of the larger story Colossal is telling—the eventual return of a mammoth-like animal to the Arctic tundra. The mice are therefore presented as evidence that mammoth traits can be engineered into a living body, turning an experimental organism into a material demonstration of the technological feasibility of de-extinction.

This logic is further reinforced by the fact that all of the woolly mice born so far are male, and Colossal has stated that it has no plans to breed them (Popescu, 2025). Their lineage, therefore, was never intended to continue. Their lives are oriented not toward their own reproduction or future, but toward validating someone else's future: the possibility of the mammoth. In this sense, the woolly mouse is a living diegetic prototype in the most literal sense—not a prototype of the mammoth itself, but of the possibility of the mammoth. Its biological existence is folded into a demonstrative function, with its future effectively foreclosed by the narrative it is designed to validate.

The woolly mouse's foreclosed future is not an isolated case but the latest iteration of a much longer history in which animal life has been shaped to serve purposes external to itself.

Objectification

The objectification of animal

Animals have long been incorporated into human systems of production and everyday life through domestication and selective breeding. Whether for meat, milk, labour, or for breeding companion animals with particular appearances, temperaments, or behavioural traits, humans have continuously reshaped animal bodies and behaviours according to their own needs (Clutton-Brock, 1992). In these practices, the value of animals gradually becomes defined by human purposes, transforming them into objects that can be intervened in, modified and optimized.

For example, in industrial livestock production, laying hens are confined in intensive farming

systems where their reproductive capacity and bodily functions are maximised for egg production (EFSA Panel on Animal Health and Animal Welfare, 2023). Similarly, pedigree breeding often relies on inbreeding to preserve breed standards, resulting in hereditary health problems such as respiratory disorders and hip dysplasia in certain dog breeds (Asher et al.,2009). Although these practices occur in different contexts, they share a common logic: animals are understood as biological resources that can be continuously "optimised" according to human needs. In this sense, design intervention first depends upon an objectifying understanding of animals.

However, this does not mean that animals become entirely passive objects of design. As Haraway (2003) argues in The Companion Species Manifesto, the relationship between humans and dogs is not one of one-way control but of co-becoming. Dogs actively shape human societies through their behaviours, capacities, and forms of cooperation, just as humans shape dogs through selective breeding. Although selective breeding involves continuous human intervention, the formation of a species still emerges through ongoing interactions between humans and animals and their environment rather than through entirely unilateral design.

It is precisely for this reason that de-extinction represents a significant acceleration of design's objectification of animals. Selective breeding already involves anticipating and selecting for desired traits, so the difference is not that specification is new, but that de-extinction intensifies it: rather than selecting among variation that already exists in living organisms, design intervention increasingly specifies the genetic constitution of life directly, before that life exists at all. This intensification first occurs at the technological level. Through comparative genomics, CRISPR gene editing, somatic cell nuclear transfer, and assisted reproductive technologies, design intervention extends from modifying existing organisms toward shaping the very conditions through which life comes into being. Designers no longer only determine which animals should reproduce, but increasingly which genetic variations should be introduced, which traits should be expressed, and what ecological functions future organisms should perform. As technological intervention becomes increasingly sophisticated, animals are progressively understood as biological systems that can be disassembled, edited, and reassembled. DNA therefore ceases to function merely as a medium for explaining life and instead becomes an operational interface through which life itself can be designed. Consequently, life is further transformed from the object of design into its raw material and operational medium.

This objectification is further reinforced through narrative practice. Public representations of de-extinction rarely reveal the complete experimental process. The potential welfare risks and experimental uncertainties involved in cloning, genetic engineering, captive rearing, and reproduction often remain less visible than successful outcomes (Browning, 2019). Instead, audiences are presented only with successful outcomes, such as the Woolly Mouse, highly realistic visualisations of the woolly mammoth. Narrative therefore does more than communicate scientific achievements; it actively determines which animal lives become visible and which are excluded from public imagination. Animals enter public narratives not because they exist as living beings, but because they demonstrate the success of technological practice. Through this selective visibility, narrative practice further objectifies animals by transforming them into evidence of technological achievement.

Finally, objectification is reinforced through the way animal value is redefined. As discussed in the first section of this paper, Colossal consistently presents mammoths, dire wolves, and other de-extinct animals as solutions to environmental crises. Their value is justified through

their anticipated functions—restoring Arctic grasslands, mitigating climate change, increasing biodiversity, and repairing damaged ecosystems. Consequently, these animals are valued less for their existence as living beings than for their capacity to fulfil predetermined human objectives. Species therefore shift from being the subjects of conservation to becoming instruments of conservation. They are framed as technological fixes that employ biotechnology to address ecological problems created by human activities. In doing so, the value of animal life becomes increasingly grounded in instrumentality.

Conclusion

Taken together, de-extinction does not resolve the gap between the imagined and the engineered animal; it repeatedly reproduces it. Technological practice decomposes the animal into editable traits in order to construct human-defined versions of species such as the mammoth or the dire wolf. Narrative practice then conceals this unresolved uncertainty behind images of a complete, coherent and relatable species. Narrative practice then frame these revived animals for the ecological or symbolic function it is designed to perform, the animal's subjectivity and agency become secondary to its position as a technical solution. De-extinction is therefore best understood not as a technology of returning extinct species, but as a design practice that produces new species-objects through the very gap it claims to close. Attending to this gap rather than treating it as a temporary technical limitation reframes Colossal's de-extinction venture as a site where design, narrative, and ethics inescapably intersect, and where the question of what we owe to a designed animal remains, for now, lacking.

References

Asher, L., Diesel, G., Summers, J. F., McGreevy, P. D., & Collins, L. M. (2009). Inherited defects in pedigree dogs. Part 1: Disorders related to breed standards. The Veterinary Journal, 182(3), 402–411. https://doi.org/10.1016/j.tvj.2009.08.033

Auernhammer, J., & Ford, C. (2022). What is design? The semantic core and periphery of design definitions. In G. Goldschmidt & E. Tarazi (Eds.), Expanding the frontiers of design: A blessing or a curse? Design Thinking Research Symposium 13 (DTRS13) (pp. 24–37). DesignTech, Faculty of Architecture & Town Planning, Israel Institute of Technology.

Bates, L., Fishlock, V. L., Plotnik, J., de Silva, S., & Shannon, G. (2025). Knowledge transmission, culture and the consequences of social disruption in wild elephants. Philosophical Transactions of the Royal Society B: Biological Sciences, 380(1925), 20240132. https://doi.org/10.1098/rstb.2024.0132

Bleecker, J. (2009). Design fiction: A short essay on design, science, fact and fiction. Near Future Laboratory. http://blog.nearfuturelaboratory.com/2009/03/17/design-fiction-a-short-essay-on-design-science-fact-and-fiction/

Browning, H. (2019). Won't somebody please think of the mammoths? De-extinction and animal welfare. Journal of Agricultural and Environmental Ethics, 31(6), 785–803. https://doi.org/10.1007/s10806-018-9755-2

Callaway, E. (2025). Meet the ‘woolly mouse’: why scientists doubt it’s a big step towards recreating mammoths. Nature, 639(8054), 284–285.

Clutton-Brock, J. (1992). The process of domestication. Mammal Review, 22(2), 79–85. https://doi.org/10.1111/j.1365-2907.1992.tb00122.x

Colossal Biosciences. (n.d.). Functional de-extinction. Retrieved August 30, 2026, from https://colossal.com/de-extinction/

Dunne, A., & Raby, F. (2013). Speculative everything: Design, fiction, and social dreaming. MIT Press.

Dupré, J. (1993). The disorder of things: Metaphysical foundations of the disunity of science. Harvard University Press.

EFSA Panel on Animal Health and Animal Welfare (AHAW). (2023). Welfare of laying hens on farm. EFSA Journal, 21(2), Article e7789. https://doi.org/10.2903/j.efsa.2023.7789

Ereshefsky, M. (2022). Species. In E. N. Zalta (Ed.), The Stanford encyclopedia of philosophy (Spring 2022 ed.). Stanford University. https://plato.stanford.edu/entries/species/

Haraway, D. J. (2003). The companion species manifesto: Dogs, people, and significant otherness. Prickly Paradigm Press.

IPBES. (2019). Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (S. Díaz et al., Eds.). IPBES secretariat. https://doi.org/10.5281/zenodo.3553579

Kirby, D. A. (2010). The future is now: Diegetic prototypes and the role of popular films in generating real-world technological development. Social Studies of Science, 40(1), 41–70. https://doi.org/10.1177/0306312709338325

Kluger, J. (2025, March 4). Scientists have bred woolly mice on their journey to bring back the mammoth. Time. https://time.com/7264043/colossal-biosciences-woolly-mouse-bring-back-mammoth/

Lindley, J., & Coulton, P. (2015). Back to the future: 10 years of design fiction. In British HCI '15: Proceedings of the 2015 British HCI Conference (pp. 210–211). ACM.

National Academies of Sciences, Engineering, and Medicine. (2019). Evaluating the taxonomic status of the Mexican gray wolf and the red wolf. The National Academies Press. https://doi.org/10.17226/25351

Persinger, C., & Palmer, C. (2025). Function over purity: Could this be the future of conservation? Ethics, Policy & Environment. https://doi.org/10.1080/21550085.2025.2586022

Popescu, A. (2025, March 4). Company seeking to resurrect the woolly mammoth creates a 'woolly mouse'. Scientific American. https://www.scientificamerican.com/article/company-seeking-to-resurrect-the-woolly-mammoth-creates-a-woolly-mouse/

Shapiro, B. (2015). How to clone a mammoth: The science of de-extinction. Princeton University Press.

Simon, H. A. (1969). The sciences of the artificial. MIT Press.

Spielberg, S. (Director). (1993). Jurassic Park [Film]. Universal Pictures.

Thomas, M. (2025, December 24). Watch Colossal Biosciences' woolly mouse make his first-ever Christmas extra cozy (exclusive). People. https://people.com/watch-colossal-biosciences-woolly-mouse-make-his-first-christmas-cozy-exclusive-11873885

vonHoldt, B. M., Cahill, J. A., Fan, Z., Gronau, I., Robinson, J., Pollinger, J. P., Shapiro, B., Wall, J., & Wayne, R. K. (2016). Whole-genome sequence analysis shows that two endemic species of North American wolf are admixtures of the coyote and gray wolf. Science Advances, 2(7), e1501714. https://doi.org/10.1126/sciadv.1501714

Wilson, R. A. (1999). Realism, essence, and kind: Resuscitating species essentialism? In R. A. Wilson (Ed.), Species: New interdisciplinary essays (pp. 187–207). MIT Press.

Zachos, F. E. (2016). Species concepts in biology: Historical development, theoretical foundations and practical relevance. Springer.

Zimov, S. A., Zimov, N. S., Tikhonov, A. N., & Chapin, F. S., III. (2012). Mammoth steppe: A high-productivity phenomenon. Quaternary Science Reviews, 57, 26–45. https://doi.org/10.1016/j.quascirev.2012.10.00

Author Biographies:

Yuxin Wang Yuxin Wang is a PhD candidate in Fine Art at the University of Western Australia, working at the intersection of animal ethics, bioethics, and more than human art and design.