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Harry Potter shows mirror to dire wolf de-extinction: perils of chasing ghosts of species' past

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Plain language summary

Have you ever wished you could bring an extinct animal back to life? Today, companies like Colossal Biosciences (CB) are using genetic engineering to cosmetically "resurrect" animals like the dire wolf. My article looks closely at the ethics behind this de-extinction trend, which continues to attract investments. Using the *Mirror of Erised* from the Harry Potter books as a metaphor—a magical mirror that showed viewer's deepest, mostly unattainable desires—I explored whether creating lookalikes of extinct predators actually helps nature. To do this, I drew on ecological theories and real-world conservation examples from South Asia.

I argue that bringing back an extinct species, whose ecological role is inconceivable, is largely a fantasy. Unlike the popular portrayal by the CB, a species is not just a DNA code; it is defined by its relationships within its environment; its prey/predators, competitors and most vitally, people. Not to forget, the whole ambit of species identity is a human pursuit, ranging from folk perceptions to scientific taxonomy. Based on characteristics and functional roles organisms undertake, the relational value judgment is far from objective, especially in an era of biotechnological sophistication, with tools like CRISPR. Hence, without functional roles the CB's genetically engineered dire wolves are **ecological orphans** since their ecosystems, supported by a specific climate, vanished ~13,000 years ago.

There are urgent implications of such ecologically incoherent investments for global conservation. We have limited time and money to protect nature. Every dollar spent on the dream of cosmetic equivalents that I formalise here as **Species Ghosts** of the extinct, like dire wolf, woolly mammoth, and *Tasmanian* tiger takes resources away from saving living beings that are currently dying out, like >48,600 species that are deemed threatened by extinction, according to the IUCN. Hence, instead of trying to reverse the past, we should use our resources to protect the ecosystems at hand. If we want to marvel at extinct giants, we can use tools like artificial intelligence and 3D holograms to educate the public safely. Let's leave the species ghosts in the past and focus on keeping the living alive.

Abstract

1. Conservation faces a paradox. As urban expansion and industrial-scale agriculture erode relational values between people and nature, a privileged minority dictates global biodiversity narratives. This shift is reinforced by media and technological interventions that frequently override lived, local experiences. For instance, gene editing tools like CRISPR incorporated for de-extinction projects to resurrect the dire wolf signals a shift toward technology-mediated conservation spectacle. Such efforts limit species as genomic artifacts and not ecosystems of constituent community-processes and self-sustaining populations. This raises urgent questions about ecological coherence of power and priorities: *whose desires drive restoration/resurrection biology, and what ongoing extinctions are sidelined in the process?*
2. Drawing on ecological theory, field insights from South Asia, and critical engagement with de-extinction discourse, this article examines the ecological and ethical implications of engineering genomes to produce lookalikes of the extinct. Using the dire wolf as a case study, I contrast individual-level pseudo-mimicry with population-level processes that sustain species through trophic interactions, microbiomes and landscape contexts. I argue that conservation anchored in functional ecology must prioritise living systems over nostalgic reconstructions of the past.
3. I evaluated in fictional ecosystem depictions, e.g., *Jurassic Park*, reflecting de-extinction conservation politics. Like *the Mirror of Erised* in Harry Potter, such resurrections reveal collective longing minus ecological backdrop. In contrast, emerging artificial intelligence (AI) technologies offer powerful, non-invasive alternatives: immersive visualisation, holography and digital reconstruction can democratise public engagement with extinct species at a fraction of the ecological and financial costs. AI can enhance storytelling, education and historical understanding without diverting scarce resources from urgent conservation crises. The challenge is not technological capacity, but ethical direction.
4. Conservationists must resist the seductive appeal of ecologically perilous **Species Ghosts.** Vultures—not dire wolves—embody the appropriate species for resurrection. Their catastrophic, human-driven global declines illustrate how ecosystem services, rural livelihoods and public health intertwine. Investing in vulture recovery foregrounds ecological function, social justice and coexistence, rather than spectacle. We must aim to secure species' viable populations, habitats and people–nature relationships. In the *Anthropocene*, the priority is not to resurrect the irrecoverable past, but to prevent the imminent Sixth mass extinction unfolding before us.

1. Introduction

It does not do to dwell on dreams of de-extinction and forget the living

- Albus Dumbledore, to conservationists

1.1. De-extinction for ecological atonement

In the Harry Potter series (Rowling, 1997), *the Mirror of Erised* captivated those who gazed in it (Fig. 1). The magical mirror did not display real-time reflections but instead revealed the observer's most fervent wishes and desperate desires. The name "*Erised*" is desire spelt backwards. For conservation, the mirror serves as a fitting allegory: aspirational species curations offer a magical escape from the despondency about continued biodiversity loss, excusing our inertia. It validates the desire to resurrect what is already lost rather than doing the difficult work of protecting the living. This argument sits at the core of ethics, prioritising *what, how, and why to conserve*. While this magical mirror had the potential to provide momentary solace, it simultaneously presented a hazard, capable of trapping an individual within an unattainable fantasy (Rowling, 1997). For some experts, the resurrection of dire wolf *Aenocyon dirus*—a formidable predator that went extinct ~13,000 years ago (O'Keefe et al., 2023)—mirrors such desires: to undo the past and restore some lost icons for ecological atonement (e.g., see phylogenetic history in Perri et al., 2021). Popularised by the *Game of Thrones* series (Fig. 2) and fossil records from the *Pleistocene*, the dire wolf recently captivated our imagination as a symbol of a wilder, untamed world.

In the fictional series Harry learnt *the Mirror of Erised* offered "neither knowledge nor truth," only stagnant fantasy visualisation. Biodiversity conservation must expectedly prioritise the dynamic and evolving nature of social-ecological relationships. Hence, the current era, characterised by CRISPR and artificial intelligence, affords certain parallels to the mirror of *Erised's* magical undertones (Anthem & Westerman, 2021; Höglund, 2025). This subtly reinforces Dumbledore's cautionary advice in Rowling's fiction: we must refrain from altering life forms and ecosystems while human impacts simultaneously disregard established, lived systemic realities (Rowling, 1997).

Fig. 1. *The Mirror of Erised* in the first book in Harry Potter series, (Rowling, 1997), captivated its observer by reflecting their deepest, most desperate desires, not reality. For Harry, who lost his parents as an infant, it offered a comforting but paralysing illusion of his lost past, illustrating the danger of becoming trapped by unattainable fantasies at the expense of the living present. Image generated using Gemini AI.

1.2. Executing de-extinction

In early 2025, Colossal Biosciences (CB) popularised its take on de-extinction. It claimed to have achieved its goal of reviving extinct species by presenting to the world *Romulus* and *Remus*, arguably the first dire wolf pups in the *Holocene*. They were named after the mythological founders of the city of Rome, who survived by suckling on a she-wolf. This feat, accomplished through genetic engineering on grey wolf cells and surrogacy in domestic dogs, gained enormous media traction. With the Dodo *Raphus cucullatus*, Woolly mammoth *Mammuthus primigenius*, and Tasmanian tiger *Thylacinus cynocephalus* on their to-do list, the CB has plans to exhibit resurrection of more extinct species (Seddon, 2017). Although early humans hunted woolly mammoths, evidence suggests climate change was the primary cause of their extinction. As the last Ice Age ended, warming climates destroyed 90% of their habitat (Sedwick, 2008). However, the other two went extinct due to direct human interventions: (i) the dodo bird went extinct in the late 17th century (last sighting 1662) due to human-driven environmental changes on its only home, Mauritius. Sailors hunted them, but the primary causes were invasive species—rats, pigs, monkeys, and dogs—introduced by settlers, which devoured eggs and destroyed nests, combined with habitat loss (Gross, 2024); (ii) the Tasmanian tiger, perceived as a threat to sheep, went extinct primarily due to intensive hunting driven by government-backed bounties, habitat destruction, and competition with introduced species between 1830 and 1920 (Brook et al., 2023). The CB has been using advanced tools, such as CRISPR/Cas9 (Höglund, 2025), for cosmetic genomic corrections, effectively cloning the appearance for conceptual optimism about resurrecting the extinct.

Additionally, the firm announced the establishment of a biovault in February 2026 to house millions of cryopreserved cells and tissue samples derived from over 10,000 species under threat. This endeavour is supported by funding from the United Arab Emirates (Colossal BioSciences, 2026; Perri et al., 2021). However, the pursuit of de-extinction, particularly in the context of reversing regional population declines/extinction, is not a recent endeavour. For over a century, translocations of individual organisms have generated both hope and reservations (Gaywood & Stanley-Price, 2022; Pearce et al., 2026; Sarrazin & Barbault, 1996; Tielke & Vos, 2024). Contemporary advancements, including sophisticated medical technologies, improved air transport, increased resource availability, and global convergence on cooperation for biodiversity conservation, have facilitated both pragmatic and ambitious ecological restoration efforts (Gaywood & Stanley-Price, 2022; Y. Jhala, Gopal, et al., 2021; Thévenin et al., 2018; Tordiffe et al., 2023). Conservationists hold varied opinions regarding these endeavours, with critics often asserting such efforts lack sufficient justification and misappropriate crucial resources from imminent extinctions (Byrne & Pitchford, 2016; Gaywood & Stanley-Price, 2022; Gopalaswamy et al., 2022; Seddon, 2017). Conservation, therefore, is not just biology; it is an inherently political exercise. Constrained by

finite time, space, and funding, we must constantly negotiate competing tangible and intangible demands to decide what gets saved (Dickman, 2010; Y. Jhala, Gopal, et al., 2021). Consequently, conservation policy implementation is rather contentious, often based on poor inclusion of stakeholders and a frequent neglect of social-ecological priorities (Bennett et al., 2017; Echeverri et al., 2018).

There is a deeper issue beyond funding debates—a partial understanding of how species and ecosystems intertwine. Ecosystems are not merely static environmental settings but rather dynamic, self-sustaining functional units of living nature (Bonebrake et al., 2025). These functional units encompass community networks among species that autonomously uphold population viability across all trophic levels (Dutta & Krishnamurthy, 2024). Such interdependent trophic interactions based on gradually achieved relationships constitute functional ecology within ecosystems, e.g., between prey and predator (Dawkins et al., 1997; Estes et al., 2011).

Ecosystems in the erstwhile dire wolf ranges have evolved since then, without those top predators. And most of the species that were around since the onset of the *Holocene* exist (Carpenter et al., 2001). Understandably so, aspirations to de-extinct species overlook how ecosystem processes ensure niche emergence—a technical term for the functional role organisms play, from pollinating plants to controlling prey populations. These niches determine whether population(s) of a new species can withstand environmental changes, while maintaining viability under pre-existing community dynamics. There is always a possibility that new introductions disrupt the existing ecosystem processes, potentially sifting it to an alternate dynamic state of communities. Life on earth has been a saga of this constant struggle, with populations pitted to maintain viability. It underscores the importance of dynamic relational states, against the backdrop of changing environments (Hussain & Baumann, 2024; Ingeman et al., 2022; Pocheville, 2015).

Within the limitations of community dynamics, the ecologically incoherent commissioning of a few individuals resemble the *Resurrection Stone*, a Deathly Hallow in Rowling's books, which allowed the user to recall shades of deceased loved ones, acting as a conforting bridge to the bearer (Rowling, 1997). This article employs such allegorical opportunities from the Harry Potter series and other fictions to help readers with easy comprehension of concepts, whose inadequate understanding gives room to superlative desires disguised as genuine conservation concerns (Pak, 2016). The broad appeal of the fictional series could assist readers in policy scrutiny, helping address unresolved questions about coexistence with nonhumans. For instance, street-dog policy in India is facing major public backlash, despite being designed to protect public health. Court directives are barking up the wrong tree due to poor comprehension of urban

ecosystem processes (Kumar & Coulson, 2026). Apart from coining a new term **Species Ghost** for ecologically incoherent incorporation of nonhuman individuals (Fig. 2), I also suggest how public impact of paleo-zoological research can rather incorporate emerging artificial intelligence (AI)—a technological resurrection. AI offers a powerful, non-invasive alternative to CB's attempts, at a fraction of the ecological and financial costs.

Fig. 2. The illusion of de-extinction: Colossal Biosciences' use of CRISPR to engineer cosmetic genetic corrections into the grey wolf genome is akin to standing before *the Mirror of Erised* with a grey wolf, gazing at the desired reflection of a dire wolf lookalike. This artificial genomic sculpting does not constitute a true species resurrection. Instead, it creates what I term a "**species ghost**"—a concept introduced in this article to define a set of lookalikes that lack integration into functional ecosystem processes. Applying the "**species ghost**" designation to all efforts aimed at resurrecting long-lost species provides a necessary framework to critically evaluate these projects across their various stages, from the initial introduction of a few individuals to the ultimate, highly complex goal of autonomous social-ecological integration. Image generated using Gemini AI.

2. Ecosystems and species

2.1. Ecosystems and species: a delicate balance in the Anthropocene

Ecosystems, the integral, living fabric of nature, ought to be self-sustaining. In contrast, species' identities represent (at their most effective) human classifications of life-worlds, possessing varying degrees of conceptual accuracy (Darwin, 1859; Levin, 2005). Some worrying statistics surround these inaccuracies: about 65% of people live in urban areas that occupy less than 4% of the Earth's terrestrial surface (UNO, 2018); and we have not documented more than 80% of all eukaryotic species (May, 1988; Mora et al., 2011). Given that built environments negatively impact biodiversity, these sobering figures underscore the dangers of diminishing people-nature connections in the 21st century (Turton-Hughes et al., 2024). As cities represent the fastest-expanding habitat type for both humans and other species, globally, (Angel et al., 2011; Bonebrake et al., 2025), this trend leads to the homogenisation of biodiversity, but also brings uniformity to the people and nature encounters that shape personalised ecologies (Gaston et al., 2023).

Contrary to popular beliefs, the living world is not an expression of beautiful harmony (Flake, 2000). Instead, nature is driven by the persistent struggle of organisms competing to attain life history goals (survival and reproduction), creating a complex, functional, and often chaotic web of ecological relationships (Flake, 2000; Gleick, 1998). This canvas of life worlds' expressions stretches from the coastline and forests like the Indian Western Ghats to megacities where nature exhibits resilience within infrastructure (Alberti, 2008; Beumer & Martens, 2015; Bonebrake et al., 2025).

Humans, arguably, have caused the ongoing sixth mass extinction that began with the Industrial Revolution, resulting in an unprecedented biodiversity loss caused by a single species (McCallum, 2015). Biodiversity loss affects the tangible as well as intangible interconnectedness and sustainability of diverse ecosystems (Alberti et al., 2003; Brose & Hillebrand, 2016). This phenomenon is particularly salient in tropical regions of the developing world, which not only harbour the highest concentration of species but also accommodate the largest human populations that are projected to undergo the most rapid urbanisation (Anonymous, 2016). Proponents of de-extinction often conveniently ignore that species do not exist in isolation but sustained by their ecological niche within complex food webs (Pocheville, 2015).

2.2. The fallacy of artificial genomic sculpting: individual lookalikes are ecological orphans

A fictional depiction of resurrection, similar to the dire wolf, and its implications, were presented in *Jurassic Park*. The movie erroneously postulated how fossil DNA from an ambered mosquito's gut supposedly contained dinosaur blood cells. This dinosaur DNA with missing genome segments was 'repaired', filling gaps using frog DNA to bring back what was lost some 65 million years ago (Brusatte et al., 2015; Spielberg et al., 1993). The fiction involved somatic cell nuclear transfer (conceptually similar to the cloning of Dolly in 1996, though the film came in 1993), and showcased revival of a select few extinct giants. Such depiction neglected shifts in the vegetative community since their disappearance. Evidence strongly suggests an asteroid or comet impact with Earth resulted in extensive wildfires, acid rain, and solar blockage, which precipitated a drastic, immediate climatic transformation (Brusatte et al., 2015; Spielberg et al., 1993).

Natural selection functions as the operative mechanism that actually sculpts and determines genomic architectures (Darwin, 1859). Organisms adapt to fluctuating extrinsic and intrinsic factors. These interactions influence survival and reproductive success within a dynamic ecosystem of interacting populations competing for limited resources (Bateson, 2017). In the natural world, survival is not contingent upon the choicest individuals, like CB's dire wolves or dinosaurs in controlled environments of cages in *Jurassic Park*. Rather, it is contingent on how self-sustaining populations operate within the limits of biogeochemical cycles and the web of interconnected life. Consequently, a finite set of individuals that pseudomimic some phenotypic features of extinct species, would constitute ecological orphans without their original prey or competitors in shared ecosystems (Coltrain et al., 2004; Darwin, 1859; Finzi et al., 2011). Genuine Batesian or Müllerian mimicry (Bates, 1862; Robinson et al., 2025) necessitates the coexisting populations of both models and mimics. The latter acquire semblance in appearances and other characteristics, based on traits that extend ecological advantage to the model species' populations.

2.3. The natural history of dire wolf extinction, and forced/accidental introductions

The dire wolf once roamed North America, a top predator that shaped ecosystems by hunting megafauna like bison, maintaining ecological restraint on herbivore populations (Coltrain et al., 2004; Fox-Dobbs et al., 2007). Its extinction, likely driven by climate shifts and prey scarcity around 13,000 years ago from the most well-known site, Rancho La Brea (O'Keefe et al., 2023), was not just a singular event but a ripple across the ecosystems and landscapes it mutually shaped. O'Keefe et al. (2023) suggest that Pre–Younger Dryas megafaunal extirpation from its bastion in Southern California was linked to anthropogenic fire-driven state shift. It indirectly implicates humans in driving these mega-herbivore and predator extinctions (Malhi et al., 2016; Perri et al., 2021). However, these extinctions are different from the ongoing massive

plundering of habitats across the globe, affecting species that inhabit them (Mora et al., 2011); even human nature of resource aquisition has changed drastically. The writing about the dynamic status of life forms is on the wall: changing environments have constantly been reshaping the web of life. More than 99% of all species that ever existed on Earth have been lost (May, 1988; McCallum, 2015), and the dire wolf's niche vanished with rapid and widespread environmental changes, stressed by rapid warming and a megadrought, which affected large herbivores (Malhi et al., 2016; O'Keefe et al., 2023).

Archaeological evidence indicates that the extinction of the predator-prey duo, as seen with dire wolves and large herbivores, was not an isolated event. For example, sabre-toothed cats evolved independently three times during the 40-million-year history of the *Felidae* family. These evolutionary events were independent and consistently corresponded with the simultaneous emergence and subsequent decline of mega-herbivores. Under such circumstances, sabre-tooth features were adaptive traits that presumably lost their selective advantage (Malhi et al., 2016; O'Keefe et al., 2023; Paijmans et al., 2017). Hence, mistaking a handful of individuals for a species undermines the autonomy of ecosystems. Only viable populations could persist and respond to future environmental changes (Höglund, 2025) . At best, such dire wolf lookalikes may serve as museum pieces valued disproportionately high. Even popular depictions of ecosystem processes, such as those in *The Jungle Book* (Law of the Jungle, based in the Central Indian forests) and *The Lion King* (Circle of Life within African savannah in Serengeti, Tanzania), illustrate the interdependence of species. Specifically, they demonstrate how the survival of herbivores (e.g., deer in forests) that consume vegetation is intrinsically linked to how predators (such as tigers and lions) influence, keeping a restraint on prey (Kipling et al., 1926; Lolang et al., 2023).

3. The Natural history of Anthropogenic Selection

Human niche expansion augmented people-nature relationships

The expansion of the human niche began in Africa approximately 70 thousand years ago. It was driven by a gradual enhancement of human capacity to inhabit forest and desert biomes, enabling a shift beyond reliance on savannah-type habitats (Hallett et al., 2025). This widespread proliferation into previously sparsely populated territories likely accounts for the enhanced human capacity to adapt to diverse habitats. Over time, however, human land-use practices across varied biomes have converged, subjecting highly diverse nonhuman biota to similar anthropogenic stressors—turning the historical ecological dynamic back on its head (Celis-Diez et al., 2017; Hughes et al., 2022). Consequently, the ecological plasticity that historically supported diverse forms of human-nonhuman coexistence is now pushed to its limits across rapidly homogenising landscapes (Abel et al., 2006; Adams & Hutton, 2007; Bang et al., 2007; Bhatia et al., 2021; Gaston, 2010; Gupta & Kumar, 2024; Jarić et al., 2022; Maffi, 2001; Soga & Gaston, 2016).

The charisma surrounding species curation efforts has been overwhelmingly dominated by mammals (Lorimer, 2007), including the highly speculative de-extinction projects advanced by CB (Colossal BioSciences, 2026). Concurrently, wild mammalian biomass has declined by more than 70% since 1850, largely supplanted by livestock and human populations (Greenspoon et al., 2025). Endeavours to establish morphological resemblance in fictional narratives and through CB's practices constitute anthropocentric assertions on nature. These human-engineered alterations to life forms are fundamentally different from how such relationships were historically established through cohabitation and domestication (Larson, 2025; Marques & Marques, 2020). Human origin and dispersal, and colonial control across multiple continents, are fraught with examples of species introduced to suit non-native needs (Buckley & Catford, 2016).

3.1. The ripple effect of introductions within ecosystems

Introductions (whether deliberate or accidental), reintroductions, or translocations of organisms invariably create ecological ripples, necessitating clear evaluation of trade-offs associated with objectives (Byrne & Pitchford, 2016; Gaywood & Stanley-Price, 2022; Pearce et al., 2026; Sarrazin & Barbault, 1996). For instance, resurrecting long-lost species that evolved based on functional roles served in the distant past is similar to what Rowling conveyed in Harry Potter's magical realm. The species ghosts cannot return unchanged, contextualising the dynamic nature of ecosystems and environments that shall prevent re-entry when the corresponding niche is non-existent (Pocheville, 2015). Any dire attempts at such forced introductions would induce ecological disturbances across the shared web of life (Levin, 2005).

Officials from the CB went far, asserting the potential incorporation of species ghosts in umbrella species roles for conservation initiatives. The firm proposed that such de-extinction of an erstwhile predator could potentially stimulate financial support for widespread habitat rewilding projects (Novak, 2018), which sidesteps the umbrella concept (Kau et al., 2025). Such poorly justified allocation of space, time, and other necessary resources against poor justification is concerning. Countless populations are already confronting imminent threats to maintaining viability within fragmented, often small, protected areas, surrounded by expanding human-use landscapes (Clark et al., 2013; Ghosh-Harihar et al., 2019; Y. Jhala, Gopal, et al., 2021; Ranjan et al., 2025; Watson et al., 2014).

3.1.1. Cases of plant introductions

Historically, colonial settlements introduced diverse plant species for food, livestock, fuel, infrastructure or aesthetic purposes (Beinart & Middleton, 2004). These large scale species intruductions often triggered biological invasions that disrupted local ecosystems, inadvertently. These unchecked introductions—whether deliberate, such as *Lantana camara* and water hyacinth (*Pontederia crassipes*), or accidental, like

carrot grass (*Parthenium hysterophorus*)—have irreversibly altered many ecoregions (Abba & S, 2025; Bhagwat et al., 2012; Patel, 2011). Such invasions arrest native community succession dynamics. For instance, *Lantana*, initially introduced as an ornamental hedge from Mexico, has proliferated across more than 60 nations over two centuries, stifling native flora for over two centuries (Bhagwat et al., 2012). Terrestrial invasions frequently manifest through allelopathy, while aquatic invasions drive eutrophication (Geletu, 2023; Williams & Hecky, 2005). Notably, recent studies indicate that intact communities of large native herbivores play a crucial role in maintaining vegetation structures that resist such invasions (Bhagwat et al., 2012; Kato-Noguchi & Kurniadie, 2021; Mungi et al., 2023; Singh et al., 2003).

3.1.2. Cases of animal introductions

Similar ecological cascading occurs with animal introductions, the implications of which are starkly visible on isolated island ecosystems. In the Andaman and Nicobar Islands, India, the deliberate introduction of Asian elephants (*Elephas maximus*) and chital/spotted deer (*Axis axis*) indirectly depressed the structural complexity of native vegetation, affecting local life forms reliant on that flora for forage or refuge. Simultaneously, the accidental invasion of the Indian bullfrog (*Hoplobatrachus tigerinus*) in the early 2000s caused severe ecological disruptions. As a highly carnivorous invasive species, its rapidly spreading populations—including its tadpoles—predate heavily on native aquatic species, threatening endemic biodiversity and disrupting local livelihoods (Ali, 2005; Mohanty et al., 2016, 2021; Mohanty & Measey, 2019).

3.1.3. Canidae: past, present and the future

If aforementioned incorporation of alien species individuals can so profoundly destabilise an ecosystem's succession and food web, the proposition of introducing a resurrected *Pleistocene* apex predator in the 21st century warrants intense scrutiny. Since the extinct dire wolf served as a top *Canidae* predator, we must contextualise this family's present day ecological niches. Today, these carnivores occupy a remarkable ecological spectrum, ranging from apex predators in wilderness areas to commensal species in urban environments. Modern times mark a critical epoch for canids, necessitating rapid adaptation to an expanding "human niche" (Boyd et al., 2011; Hallett et al., 2025; Hussain & Baumann, 2024; Schleidt & Shalter, 2003). For South Asia, the Indian grey wolves *Canis lups pallipes* face threats from habitat degradation and genetic introgression from Free-ranging dogs *Canis lupus familiaris* (FRDs), while Asiatic wild dogs *Cuon alpinus* circumvent declining populations and disease transmission risks. Alongside, Indian foxes *Vulpes bengalensis* and Golden jackals *Canis aureus* demonstrate remarkable behavioural plasticity around human-use landscapes. Such divergent *canidae* ecological trajectories amidst urbanisation and

habitat modification hardly leave room for ornamental curation of habitats for dire wolf or similar fantasy projects. Additionally, with ~800 million FRDs and other canids across the world, the autonomous existence of dire wolves beyond curated systems seems improbable. Contemporary ungulate populations that shall support the introduction of predators are constrained by habitat degradation and invasive species' impacts, restricting the carrying capacity for existing large-bodied predator populations (Carricondo-Sanchez et al., 2019; Gompper & Gompper, 2013; Kumar & Coulson, 2026; Kumar & Sharma, 2025; Vanak & Gompper, 2009).

3.2. The paradox of driving species extinctions while engineering de-extinction

Non-native species introductions disrupt ecosystem functions. But beyond biophysical impacts, perceptual accounts/definitions to understand nature—such as what constitutes a 'species'—often modulate our understanding of local ecosystems. Ultimately, the scientific (western) concept of species does not represent "real objective units" (Darwin, 1859; Gupta & Kumar, 2024; Mayr, 1996) but humanistic constructs of varying accuracy. With time, popular (folk) perceptions and practices give way to how taxonomists utilise an array of morphological and other indicators to categorise and denominate species. Top-down, homogenised policies often miss the diverse relationships that local communities developed with nonhumans through long-standing coexistence (Kumar et al., 2019).

Previously, popular (folk) perceptions identified animal identities based on habitat or ecosystem services of commensals and other life forms (Dave, 2005; Gupta & Kumar, 2024). Many indigenous communities have been studied for valuing wildlife, like lions *Panthera leo leo* in Africa (Western et al., 2019) and elephants in Assam (Barua, 2014). However, the ongoing socio-cultural erosion has depleted traditional ecological knowledge TEK (Houde, 2007). It accounts for the difficulties in reconciling conflicting choices arising from the threats of nuisance, injuries, and zoonotic diseases posed by animals (Allen et al., 2017). For instance, apex carnivores, and elephants, wild pigs etc. that frequent human-dominated areas, and the current socio-legal deadlock within the Indian Supreme Court about continued free-ranging status of street dogs (Kumar & Coulson, 2026), represent examples of evolving interfaces with nonhumans. Such changes are frequently associcted with countless examples of top predators and herbivores conflicting with local communities (e.g., see Bagchi, 2019; Barua, 2010, 2014; Braczkowski et al., 2023; Nyhus, 2016; Schell et al., 2021; Torres et al., 2018; Yeo & Neo, 2010).

Coexistence conundrums underscore a difficult ecological reality: wide-ranging predators/wildlife that persist within and outside protected areas adapt to anthropogenic landscapes. For instance, wolves in the Indo-Gangetic plains navigate mosaics of croplands, settlements and remnant vegetation. In environments where natural prey is reduced or patchily distributed, individuals may exploit vulnerable targets, including unattended livestock and, in rare but severe cases, children. Accumulating evidence suggests increased behavioural plasticity in modified ecological contexts, thereby challenging reductionist accounts of predator recovery. The recent wolf attacks on children in Bahraich district, Uttar Pradesh, illustrate this tension. In 2024–26, several children were reportedly taken from villages bordering agricultural fields and scrublands where wolves move through fragmented habitat, triggering fear, retaliatory pressures, and intense media scrutiny (Ahmad et al., 2025). If species populations are to occupy shared landscapes beyond protected areas, conservation must account for risk mitigation, compensation systems, habitat structure, and community preparedness. Romanticised visions of large predator resurgence rarely anticipate and prepare to confront these harsh realities of predator recovery in human-use landscapes (Bagchi, 2019; Ripple et al., 2014; Wolf & Ripple, 2016).

3.3. Ecosystem and species health across scales of social-ecological organisation

Moving ahead, efforts to curate species often miss potential physiological and eco-evolutionary mismatches. In an era defined by zoonotic spillover risks, conservation must account for species' microbiome (Gaywood & Stanley-Price, 2022; Poulin et al., 2023), which is highly specialised, and dictates host physiology and behaviour—the gut-brain axis hypothesis (Petrullo et al., 2025). Additionally, there is likelihood of life-history traits and circadian rhythms mismatch when individuals adapt to new climates (Lin et al., 2021; Losey et al., 2022; Luca et al., 2010; Petroelje et al., 2019; Poulin et al., 2023). For instance, following the Cheetah's *Acionyx jubatus jubatus* extinction from the South Asian wilderness in 1952, the Indian government executed a re-introduction project in September 2022 at Kuno. This happened after a long and arduous socio-legal battle since 1992. The legal tussle concerned competing priorities about seeding Asiatic lions *Panthera leo persica* in the same park, outside their endemic status within Gir landscape in western India since the late 19th century. However, the project encountered difficulties when introduced Cheetah individuals developed winter coats during the warm and humid season in India (May - August 2023). Winter coat timing, which caused issues of maggots under tracking collars, was a physiological response rooted in prior circadian rhythms of their native Namibian climate-zone (Biswas, 2023). The project faced impediments, despite a comprehensive assessment of potential impacts and habitat suitability, done at prior (Y. Jhala, Ranjitsinh, et al., 2021).

Cheetah individuals responding to novel social-ecological conditions has been creating management complexities associated with evolutionary hard wired behavioural and physiological traits expressed within and outside Kuno, a central Indian reserve (Biswas, 2023; Tordiffe et al., 2023). Remarkably, both lion and cheetah coexisted in vast north Indian landscapes. It remains unclear which of the two predators has deviated further from Kuno's present-day ecosystem, subsequent to the social-ecological changes that followed their local extinctions. Settling competing priorities is complex, given that lions are pride dwelling, and ambush predators, unlike Cheetahs. The resultant costs associated with people-predator coexistence will encompass the ramifications stemming from the regrettable losses of livestock and human lives, in addition to the ecological succession dynamics within habitats confronted with biological invasions from lantana (Biswas, 2023; Dickman, 2010; Gopalaswamy et al., 2022; Y. Jhala, Gopal, et al., 2021; Y. Jhala, Ranjitsinh, et al., 2021; Y. V. Jhala et al., 2019; Western et al., 2019).

Several conservationists have questioned the ecological suitability and the social-ecological consequences of such resurrection initiatives (Gopalaswamy et al., 2022). Varied opinions suggest that species curation endeavours, particularly in regions like South Asia with numerous small protected areas, could draw major lessons extended by the challenges of conserving tigers within human-use landscapes. The Project Tiger and All India Tiger Monitoring project demonstrate that success is contingent upon the strengthening existing ecosystems. By safeguarding native forests, we simultaneously conserve tigers and co-predators, their prey, avifauna, etc., and vegetation and soils—a complete web of life integral to their respective ecosystems (Y. Jhala, Gopal, et al., 2021).

The current global cooperation convergence over conservation necessitates judicious prioritisation and meticulous planning to afford successful integration of individuals into regional niches (Hussain & Baumann, 2024; Regos et al., 2021; Shaner & Ke, 2022). The resurrection strategies proposed by CB, involving laboratory-designed species ghosts and analogous organisms, warrant priority evaluations of investing finite resources and time. For instance, pack-living canids, including modern wolves, wild dogs, and the extinct dire wolf, require vast territories. Given the intense spatial constraints of the modern *Anthropocene*, basic ecology dictates that first we must secure intact habitats and a robust prey base before initiating resurrection of apex predators (Y. Jhala, Gopal, et al., 2021; Tordiffe et al., 2023). Deviations risk destabilising food webs, thereby accelerating population declines, a repeat of the extinction past (Coulson, 2025).

3.4. Grounding 21st-century conservation in rigorous science beyond intuition

Because ecosystem functionality—from microbiomes to prey bases—cannot be artificially manufactured, 21st-century conservation must be grounded in rigorous science, not just intuition or nostalgia. Propositions for de-extinction that incorporate species ghosts do not align with Peter Medawar's definition of scientific endeavour, identified as *the art of the soluble.* (Medawar, 2008). Scientific methods address tangible environmental challenges, such as conserving the endangered Gangetic gharial *Gavialis gangeticus* in South Asian river systems (Khadka et al., 2022; Nair et al., 2012) and the critically endangered Great Indian Bustard *Ardeotis nigriceps* in Indian savannahs through captive breeding programs and native habitat preservation (Jangra & Verma, 2024). Gene editing could be monumental for human ingenuity. But a dire wolf severed from its *Pleistocene* context is a mere shadow of ecological reality—a genetic artefact with no functional role—which begets questions like: *Why divert effort to species' ghosts when the living need us more, especially when we still poorly comprehend our roles as a species, stekeholders and individuals* (McCallum, 2015; Mora et al., 2011)? CB's declarations and promises continue to capture headlines (Colossal BioSciences, 2026), but the Great Indian Bustard teeter on extinction's edge, with fewer than 150 individuals left in the wild due to habitat loss, electrocution and predation by FRDs in roughly 800,000 km^2 of South Asia (Dutta et al., 2011). Globally, the IUCN Red List reports over 48,600 species (including 17,000 tree species) at risk from global change (Boonman et al., 2024; IUCN, 2026).

Advancements in artificial intelligence (AI) and archaeological sciences provide a unique opportunity to appreciate historical life forms without the need for biological resurrection. Media representations of extinct species continually capture public imagination and inspire millions (Goodman et al., 2016; Nolan et al., 2022). AI and advanced archaeological sciences can now dramatically reduce the costs of these visualisations. Through immersive 3D printing, holography and digital reconstruction, we can satisfy desire to marvel at extinct giants without squandering finite conservation funds on species ghosts. Such visualisatoins could help layperson understand humanity's pivotal role as a consequential species amidst the vast array of life forms (Nature Perspectives, 2026). These technologies can also showcase the importance of people maintaining diverse relationships with nature, particularly while environments and circumstances evolve, (Gupta & Kumar, 2024). Overlooking conservation fantasy projects and approaches like CB shall save finite conservation resources. Every dollar spent on de-extinction fantasies is diverted away from protecting coral reefs, restoring wetlands, or combating poaching (Adams & Hutton, 2007; Anthem & Westerman, 2021; Bagchi, 2019; Ghosh-Harihar et al., 2019).

4. Vultures: the right poster-species awaiting de-extinction

Historical guilt over human-induced extinctions has often catalysed conservation movements, transforming former hunters into dedicated environmental stewards. The global landscape is replete with such instances (Banks & Hochuli, 2017; Büscher, 2025). For example, Jim Corbett, whose work inspired the designation of the first national park in India, initially served as a commissioned hunter of man-eating big cats (Corbett & Gobetti, 1946). But efforts in de-extinction of fauna wherein human involvement was relatively indirect, e.g., dire wolves, or species that might never afford viable ecosystems even with forced resurrection—such as the dodo (Roberts & Solow, 2003)—should yield precedence to advocating the reversal of the alarming global decline of the vulture populations (Bowden, 2009; Prakash et al., 2003). These formidable scavengers need better and collective attention from conversation community and beyond to matelrialise a comeback.

Since the 19th century, humanity's capacity to dominate ecological niches was supported by the complementary scavenging services provided by vultures (Botha et al., 2017a; Kumar et al., 2019). Ever since the rapid global declines, funds have been allocated to potential resurrection efforts via captive breeding and reintroduction of vultures into ecosystems. Alongside, teams monitor and control use of non-steroidal anti-inflammatory drugs, and deliberate poisoning in Africa (Henriques et al., 2020), implicated in the initial population decline (Botha et al., 2017b; Bowden, 2009; Prakash et al., 2003). Vultures represent a critical conservation priority. Their scavenging services facilitated the subsistence of billions of humans through protein derived from livestock. The decline of vulture species has constrained the equitability of livestock farming. This happened since carcass disposal has become a limiting factor for animal husbandry, particularly in impoverished communities across both urban and rural areas (Frank & Sudarshan, 2024; Gangoso et al., 2013). Regrettably, captive breeding programs are often not linked with appropriate planning at ecosystem or landscape context, failing to account for the wide-ranging ecology of these avian scavengers. Furthermore, spatial planning for livestock farming in megacities like Delhi does not currently align with the release program of captive-bred vultures in the northwestern peripheries of the National Capital Region in India (Gupta & Kumar, 2024; Kumar et al., 2019; unpublished research).

Socially and ecologically unmoored efforts to stem species extinction are susceptible to failures. For example, ensuring the future of wide-ranging populations of vultures, leopards, or wolves necessitates significant investment in studying social-ecological interactions, protecting requisite habitats, and mapping regional distinctions while acknowledging global congruity. Unfortunately, the costs of conservation and species recovery are often borne disproportionately by rural communities living in human-dominated landscapes. "Glocal" conceptualisations of coexistence must factor the regional costs of human-wildlife

conflicts when prioritising space or other resources for charismatic species embroiled in human-wildlife conflicts (Donázar et al., 2016; Jepson & Barua, 2015; Lorimer, 2006, 2007).

5. Conclusion

5.1. Shattering the Mirror of Erised in conservation

Life forms respond even when conservation interventions are ecologically incoherent (Hobbs et al., 2011). And ideas like de-extinctions reinforce an anthropomorphic view: that we can "fix" nature by recreating what is lost, or by translocations that may or may not be based on adequate assessment of requisite habitat conditions for a viable population. The recent success in the *Panna* and *Sariska* Tiger Reserves of central India (Dutta & Krishnamurthy, 2024), involved translocations and subsequent efforts on monitoring. These enabled the seeded Bengal tiger *Panthera tigris* individuals to constitute viable populations and re-acquire the niche of being top predators. But North America's modern predators—wolves, cougars, bears—adapted to the altered landscape have been facing human persecution since the *Holocene* (Smith et al., 2022). Reorganisation of ecological communities results in novel ecosystem states, not a landscape of 'vacant niches' waiting to be refilled (Malhi et al., 2016; Shivik, 2014; Smith et al., 2022).

Consequently, investments in de-extinction invariably raise ethical questions concerning the political ecology of conservation (Cohen, 2014): *Who decides which species return? Why the dire wolf and not the other 85 extinct mammals on the IUCN Red List* (IUCN, 2026)? Perhaps such choices reflect human biases rather than ecological needs. An alternative, proven rewilding approach involves reintroducing ecologically similar species to restore lost ecosystem services. For instance, Aldabra giant tortoises, introduced to Mauritius' Round Island, have effectively replaced extinct tortoises, grazing vegetation and dispersing seeds to revive the island's ecosystem (Arnold, 1997; Griffiths et al., 2010). Such strategies prioritise ecological function over nostalgic revival. Incorporation of traditional knowledge into contemporary eco-literacy shall address the dire need to focus on new norms for coexistence (Gupta & Kumar, 2024).

5.2. Allure of immortality: for humans and nonhumans

The allure of dire wolf resurrection must give way to the uncomfortable: confronting our place as a species. Humans fantasise immortality and visualise life after death across multiple religious and cultural identities. South Asian communities have historically incorporated nonhumans into their pursuit of afterlife goals, providing food-subsidies to various opportunistic species. Such actions modify regional ecological networks, often associated with conflicts when opportunistic species cause nuisance, injuries or diseases, polarising stakeholders that feed, and the victims (see Gupta & Kumar, 2024; Kumar et al., 2018, 2019). Much like Harry when confronting *the Mirror of Erised*, we perceive what we desire: absolute control over life-forms and mortality, e.g., the legal deadlock regarding FRDs in India (Kumar & Coulson, 2026). Here, opportunistic feeding disregards the subsequent behavioural and demographic impacts, which, in turn, increases conflicts, diseases, and deaths (Kumar & Sharma, 2025). Humanity's track record in creating self-sustaining ecosystems is poor—consider failed attempts to terraform Biosphere #2 (Cornelius, 2021), greening deserts, or aspirations to colonise Mars and the Moon by Elon Musk, which remains speculative (Douthat & Chamberlin, 2026). *If humans cannot yet build basic, autonomous functional units of living nature, i.e. ecosystems, how can we justify reconstructing extinct ones?*

Human selection pressures on nature—urban sprawl, deforestation, and anthropogenic climate change—drive concurrent extinctions (McCallum, 2015; Soga & Gaston, 2016). Instead of reviving the ecologically incoherent past, we should use science and other disciplinary approaches to secure the future for the living. Sophisticated tools like genetic sequencing can bolster endangered and endemic species' resilience, as seen in efforts to save India's Nilgiri tahr *Nilgiritragus hylocrius* (Kanagaraj et al., 2023). In nature, extinction and change in life forms that respond to environments are part of an ever-consistent dynamic. It warrants focus on *what, where and how humans have deliberately reshaped ecosystems*. We must protect to ensure autonomy of native ecosystem functions. In conclusion, curating life forms in ecosystems is tempting but perilous. Fragile ecosystems necessitate a shift away from a patronising human dominance towards prioritising ecological rationale and biocultural salience.

Since this article began with *the Mirror of Erised*, it is fitting to end with Dumbledore's parting wisdom (Rowling, 2018): "*It is our choices that show what we truly are, far more than our abilities*." Our technological reach now exceeds that of any species in history, enabling us to rapidly conceptualise and enact conservation. But the question is not whether we can intervene—it is whether we should, and to what end. As a species endowed with unprecedented power to reshape the biosphere, our responsibility lies not in demonstrating capability, but in choosing wisely which losses we prevent and which illusions we resist.

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