AN EXAMINATION OF DE-EXTINCTION: HOW DOES DE-EXTINCTION CHALLENGE BIODIVERSITY GOVERNANCE IN INTERNATIONAL ENVIRONMENTAL LAW

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Abstract

The reported success of Colossal Biosciences in 2025 to achieve the first de-extinction of Aenocyon dirus (dire wolf) has generated global fascination, yet it has largely been met with silence within the legal community. While scientists celebrate the achievement and the public marvels at its implications, international environmental law has not provided conceptual clarity on how such an unprecedented event should be situated. Whether driven by ecological responsibility or scientific curiosity, de-extinction raises profound questions that go beyond technical regulation. This paper argues that the issue must be approached through philosophical inquiry under international law, and international environmental law in particular is, at its core, a product of philosophical compromise. As such, this paper attempts to explore the motives of ecological responsibility underpinning de-extinction in relation to biodiversity. By tracing the doctrinal and philosophical underpinnings of legal obligations toward biodiversity, this article examines whether de-extinction represents a new shift toward an eco-centric paradigm or merely emphasizes existing anthropocentric frameworks. It ultimately argues that de-extinction reveals a conundrum: a biological and technologically produced organism without juridical recognition as components of biodiversity.

Keywords: *De-extinction, international environmental law, ecological responsibility, anthropocentrism, speciesism, biodiversity.*

KAJIAN TENTANG DE-EKSTINGSI: BAGAIMANA DE-EKSTINGSI MENANTANG TATA KELOLA KEANEKARAGAMAN HAYATI DALAM HUKUM LINGKUNGAN INTERNASIONAL

Intisari

Keberhasilan Colossal Biosciences pada tahun 2025 dalam melakukan de-eksistensi *Aenocyon dirus* (serigala purba) telah memunculkan perhatian global, tetapi justru banyak diabaikan oleh komunitas hukum. Sementara para ilmuwan merayakan pencapaian ini dan publik mengagumi implikasinya, hukum lingkungan internasional belum memberikan kejelasan konseptual mengenai bagaimana peristiwa yang belum pernah terjadi sebelumnya ini harus diposisikan. Terlepas dari apakah didorong oleh tanggung jawab ekologis atau rasa ingin tahu ilmiah, de-eksistensi menimbulkan pertanyaan mendalam yang melampaui aspek teknis regulasi. Artikel ini berargumen bahwa isu tersebut harus didekati melalui penyelidikan filosofis di bawah hukum internasional dan khususnya hukum lingkungan internasional, yang pada dasarnya dibentuk oleh landasan filosofis. Dikarenakan hal tersebut, artikel ini mencoba untuk menelusuri motif-motif dari tanggung jawab ekologis yang membawahi de-eksistensi dalam hubungannya terhadap keanekaragaman hayati. Dengan menelusuri landasan doktrinal dan filosofis dari kewajiban hukum terhadap keanekaragaman hayati, artikel ini menelaah apakah de-eksistensi merepresentasikan pergerakan baru menuju sebuah paradigma ekosentris atau sekadar menegaskan kerangka antroposentris yang ada. Artikel ini berargumen bahwa de-eksistensi mengungkap sebuah konundrum: keberadaan organisme biologis melalui teknologi tanpa pengakuan yuridis sebagai komponen keanekaragaman hayati.

Kata Kunci*: De-eksistensi, hukum lingkungan internasional, tanggung jawab ekologi, antroposentrisme, spesiesisme, keanekaragaman hayati.*

A. Introduction

Biodiversity loss remains one of the most pressing challenges of the modern era. International environmental law possesses frameworks ranging from the Convention on Biological Diversity (CBD) to species-specific instruments like the Convention on International Trade of Endangered Species (CITES). These instruments primarily focus on limiting further harm rather than restoring what has already been lost. Particularly for CITES, a convention primarily aimed to halt the extinction of endangered wild species,[1] the instrument itself does not address specific measures regarding a de-extinct species. While it has been argued how considering affording a de-extinct species a place in the Appendices of CITES to afford protection,[2] additional considerations should be given to potential protection afforded by CBD. One of CBD's strengths is its objective and purpose working in favor of preservation of biodiversity, ranging from provisions mandating smooth reintroduction, establishing in situ and ex situ conservation grounds, as well as integrating the very de-extinct species as "biological resources" within the auspices of CBD.[3] However, despite the attractive plausibility of CBD and CITES being the appropriate prototypical instrument and convenient means to afford some level of legal certainty, development of de-extinction under international law seems to take no further steps beyond the 2016 International Union for Conservation of Nature's (IUCN) documentation on guiding principles on de-extinction for conservation benefit meant for IUCN's task force.[4] Between that, and Colossal's success, there is not much to be looked at.

As there are no legal documents establishing a position, or affording legitimacy under both general international law and consequently international environmental law, to pursue any inquiries regarding de-extinction as a part of biodiversity restoration or promotion, one must surely raise questions not only of legal codification from observation but also of moral and philosophical considerations. Especially true in the case of codifications, the common practice of international law dictates source tracin g, primary or secondary,

1 Erin Okuno, "Frankenstein's Mammoth: Anticipating the Global Legal Framework for De-Extinction," *Ecology Law Quarterly* 43, no. 3 (2016): 588–99.
2 *Ibid*, 599–600.
3 *Ibid*, 612–513.
4 "Principles on Creating Proxies of Extinct Species for Conservation Benefir." IUCN SSC, 2016.

hard law or soft law, which contain obligations, norms, and principles to provide a legal basis as well as understanding of the underlying notion behind them.[5] In the case of moral considerations, we may take a look at Parfit's Paradox. The paradox posits that preservation efforts, if successful, may remove the necessity of future continuation of such obligation.[6] Following the previous paradox, this raises a consideration worthy scenario; the process of de-extinction is presumably expensive and extensive, the concept and process itself became widely known as early as 2012[7] , and the first success at 2025 is evidence enough to paint a general picture of expenses and difficulty. If the process becomes affordable enough to be accessible beyond highly funded scientific endeavors to be commercialized, then would it be possible for de-extinction to eliminate the need of intergenerational obligation to promote or restore biodiversity just because fauna biodiversity can be de-extincted?

Whether such an intergenerational obligation exists is also another question, one that grants merit to the current assessment effort. There are two complicated layers to this, the first layer being environmental human rights as proposed by James Nickel, which is best described as rights of groups of people[8] to a safe environment.[9] The complication lies when the former is paired with the second layer. When we consider environmental obligations to future generations, which in the case of de-extinction and the context of international environmental law relates to restoration or promotion of biodiversity, an observation proposed by Feinberg denounces any actual interests of future generations, allowing them claims against being wronged by present generations,[10] which is why it is often categorized under 'imperfect' obligations.[11] At a glance, it seems we cannot blame the ancient romans

5 Jo Lynn Slama, "Opinio Juris in Customary International Law," *Oklahoma City University Law Review* (Oklahoma) 15 no. 2 (1990): 610.

6 Anthony D'Amato, "Do We Owe a Duty to Future Generations to Preserve the Global Environment?," *The American Journal of International Law* (Cambridge) 84, no. 1 (1990): 192–94.Anthony D'Amato, "Future Generations."

7 Lucia Martinelli et al., "De-Extinction: A Novel and Remarkable Case of Bio-Objectification," *Croatioan Medical Journal* 55, no. 4 (2014): 423–27.

8 Richard P. Hiskies, "Environmental Rights, Intergenerational Justice, and Reciprocity with the Future," *Public Affairs Quaterly* 19, no. 3 (2005): 177–94.

9 James W. Nickel, "The Human Right to a Safe Environment: Philosophical Perspectives on Its Scope and Justification," *Yale Journal of International Law* 18, no. 281 (1993): 281–95.

10 and William Blackstone, "The Rights of Animals and Unborn Generations," in *Philosophy & Environmental Crisis* (University of Georgia Press; Athens, 1974).

11 Richard P. Hiskies "Intergenerational Justice" 177.

for the extinction of *Panthera tigris virgata*, or the loss of *Panthera tigris sondaica* due to conflict with the Balinese locals in the 1950s, regardless of past exposition, if any, or comprehension of the concept of intergenerational obligations and whether it is 'imperfect'. Does restoration guarantee a safe environment? Or are we merely recreating scenarios and then doomed to repeat the inevitable cycle? It does seem foolish for ancient romans to consider so far ahead into the future, considering not many of us will have the privilege to directly benefit from the existence of such diverse biota aside from inherent ecological values. De-extinction complicates this further if we were to ask whether there is responsibility in restoring those that were irresponsibly lost. Berdinesen's interpretation of Hans Jonas' "the imperative of responsibility" suggests that research technique and technology become measurements of progress, and that it is important to understand the driving force of that progress.[12] Berdinesen elaborates his interpretation on how the use of technology involves collective actions and therefore implies intergenerational obligations; as such, consequences of technological advancements, such as genetic manipulation, carry with them an ethical problem, and the subject of those very collective actions involves nature and future generations.[13] The contrasting dogmatic implications of obligation based on intergenerational considerations alone, compared to technological advancement, which might affect future generations, offer different perspectives. Whether the collective humanity bears a duty to safeguard the long-term conditions of biodiversity, which might justify de-extinction as a precautionary care for the environment and future generations, remains questionable at best. At the same time, such responsibility could be considered as far-reaching and impractical after having observed both.

As the former perspectives do not consider the legal perspective, it would be unwise to form a legal argumentation without observing the presiding norm. From the theoretical perspective, the formation of state obligation under international law is preceded by state consent, pragmatism, or manifest political will.[14] As consent forms a crucial part of the international legal system,

12 Hein Berdinesen, "On Hans Jonas' 'The Imperative of Responsibility,'" *Philosophia: E-Journal for Philosophy & Culture* 17 (2017): 17.
13 *Ibid* 16-17.
14 Marc Pufong, "State Obligation, Sovereignty, and Theories of International Law," *Politics &*

despite the existence of instruments such as CBD and CITES, one has to wonder if the current state of international law has a place, if consent is crucial, where there is seemingly no consensus to even consider de-extinction's place within international environmental law. Considering rational choice theory, in which states act in accordance with their goals which reflect analogous economic behavior of optimizing benefits while minimizing efforts,[15] it seems as though there are no benefits of de-extinction worth considering to relay effort in maximizing goals of interest to states. Moreover, the history of international environmental law has demonstrated that past developments, such as the formation of the no-harm principle from the *Trail Smelter* Arbitration, began from environmental transgression, emphasizing a common goal of interest within rational choice theory. On biodiversity alone, history shows how conservation attempts are based upon what is known, and globally speaking, there has been a general consensus on 'taxonomic impediment'; that is to say, the lack of comprehensive knowledge to succinctly manage biodiversity.[16] Beginning from the 1968 UNESCO Conference on the Use and Conservation of the Biosphere, to the 1972 United Nations Conference on the Human Environment, to the agreement pushing for a comprehensive biodiversity database in 1992 which led to the birth of CBD,[17] rational choice theory can partly cover political will of states to manage biodiversity but not so much as to promote or restore, much less so when we consider outcome of de-extinction and how it might impact or affect biodiversity.

Clearly no-harm principle and biodiversity came from very different underlying foundations despite both forming integral parts of international environmental law. Strictly speaking, in questioning de-extinction and its place within biodiversity's historical frame, there is a leap from which an underscoring of moral reasoning often precedes codification. The history also shows the lack of consensus on furthering initiatives of promotion and 'restoration' within any translatable context of de-extinction, other than to oversee and comprehensively manage biodiversity for conservation and

Policy 29, no. 3 (2001): 489.

15 Michael J. Glennon, "How International Rules Die," *Georgetown Law Journal* (Georgetown) 93, no. 3 (2005): 939–91.

16 Alexander Gillespie, *Conservation, Biodiversity and International Law*, New Horizons in Environmental and Energy Law (Edward Elgar Publishing Limited, 2011).

17 *Ibid.*

protection purposes. Ultimately, de-extinction cannot be understood solely as a technical or scientific issue. It forces reflection on the philosophical foundations of biodiversity under international environmental law: whether law should remain bound by anthropocentric assumptions or evolve to accommodate non-anthropocentric, eco-centric intergenerational values which could include de-extinction if or when necessary. In this sense, de-extinction provides not only a normative challenge but also a philosophical opportunity: to reassess how law conceptualizes obligation, responsibility, and justice in relation to the environment.

Based on the preceding introduction, this paper examines whether Colossal's success in de-extinction, if repeatable and reproducible, can contribute to preventing further risks of biodiversity loss, and legal frameworks, principles, and values might be applicable in ensuring legal certainty. Following the formulation of the first question, this paper further considers whether de-extinction reinforces the predominant anthropocentric orientation in international environmental law, or whether it opens space for a more eco-centric development. Due to the novel nature of de-extinction and its resulting organism, this paper argues that the result of de-extinction is a potentially conservable entity without a responsibility bearer. This stems from the observation that biodiversity operates with the reasonable conclusion that a species has been in existence, and that responsibility of mitigation, prevention, conservation, and sustainable use in relation to human activities follows a presumed occurrence of harm in the form of incumbent obligations.[18] As such, the follow-up question concerning anthropocentrism completes the significance of this exercise. It does so by assuming the position of criticism

18 Convention on Biological Diversity arts. 2, 7, 8, & 14, June 5, 1992, 1760 UNTS 79 (defining biodiversity by reference to existing biological diversity; conditioning conservation, in-situ measures, and environmental impact assessment on components of biodiversity "within national jurisdiction"); Convention on International Trade in Endangered Species of Wild Fauna and Flora art. II(1), Mar. 3, 1973, 993 UNTS 243 (regulating trade in species already listed as threatened with extinction); Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization arts. 5, 6, & 15, Oct. 29, 2010, UNTS vol. 30619 (triggering obligations only upon access to existing genetic resources under State sovereignty); Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity, CBD Decision VII/12, practical principles 1–3 (2004) (presuming sustainable use of existing biodiversity under management and jurisdiction); Rio Declaration on Environment and Development principles 2, 10, & 15, June 14, 1992, UN Doc. A/CONF.151/26 (Vol. I), 31 I.L.M. 874 (1992) (grounding environmental responsibility in territorial sovereignty, procedural participation, and precaution in relation to known risks).

of anthropocentric utilitarianism present in international environmental law's framework (which will be elaborated in the discussion), which confers the next step to be an assessment of whether the de-extinction endeavor puts more emphasis on human-centric prescription of values, or may open a possible valuation towards ecocentrism through scholarly classification.

In answering the first research question, this paper will delve into past arguments regarding the framework of CBD and CITES in the context of de-extinction, Colossal's success, and de-extinction's repeatability. While it is difficult to speculate whether Colossal's success can be repeated, it is important to consider through which de-extinction was done and link them to existing nuances of reality, legal or otherwise, to give a more grounded perspective. In answering the second research question, this paper will consider publications on particularities or specificities of anthropocentrism. In considering the possible findings for both questions, the author will briefly discuss speciesism and anthropocentrism, whether de-extinction as an inherently technological and therefore man-centric advancement steers away or pushes toward it more. The methodology is interpretive rather than empirical: it situates legal ideas, theories, and paradigms within their broader normative contexts, assessing their limitations and their potential to provide conscience-based considerations stemming from moral, legal, and philosophical inquiries.

B. Regarding Colossal's Success, Legal Framework, Principles, and Legal Certainty

Despite celebrations and admirations, many of the scientific opinions have been put forth and can be boiled down into the following (taken from two sample publications): Colossal Biosciences' dire wolves are not 'true' dire wolves since even though they bear dire wolf DNA, they are born through surrogate domestic dogs using genome editing of their extant distant living cousin the gray wolves,[19] and that the success might just be a vanity project and all efforts and funding must go to enhancing existing conservation efforts since bioengineering will never solve biodiversity crisis.[20] Coincidentally, while the opinions might not reflect the whole representation of any dissent

19 Michael I. Jensen-Seaman et al., "The Dire Worlf (Aenocyon Dirus) Resurrection That Wasn't." *The Anatomical Record*, 2025.

20 Jacob Höglund, "How to Clone a Dire Wolf," *EMBO Reports* (UK) 26, no. 12 (2025): 2969–70.

or agreement within the scientific community, the samples seem to indicate efforts of a similar nature in the legal world: in which conservation effort is the safer, more feasible route. For example, a sample argument taken from one legal scholarship indicates that frameworks such as CITES and CBD fall short of providing any sort of legal protection plausibility for de-extincted species as a part of biodiversity due to the limitations posed by the lack of protection and safeguarding of potential resurrected species.[21] Additionally, CBD's supplemental instrument, the Cartagena Protocol, has been argued by virtue of design to be unable to provide immediate explicit protection to de-extincted species despite the instrument's focus on effects of biotechnology.[22] Perhaps, for the sake of preliminary clarity we may be able to entertain the following possibility; due to the nature of the species, as they form part of the extant species while simultaneously containing genomic trace of prehistoric biological resources, does this mean any implied protection will then fall under the auspices of intellectual property rights instead of the protection afforded by international environmental law?

One of the fundamental principles of patenting a lifeform, in consideration of any afforded protection to the inherent intellectual property rights contained therein, is the necessity to provide incentive for innovation, diffusion, and disclosure since a lack of protection provided by the patent of the intellectual property means less possibility for commercialization of future innovative products.[23] As such, any possible patent application following the success of Colossal Biosciences' de-extinction effort is integral in ensuring the continuation or repeatability of the endeavor. The current development following the success is that Colossal has filed patent applications, but instead of patenting the lifeforms, the company chose to apply for a patent on the technology responsible for the success since Colossal's CEO stated how patenting the wolves means categorizing them as 'articles of commerce' instead of creatures returning to their supposed ecosystem.[24] This sentiment somewhat aligns well with the importance of conservation within the context of

21 Okuno, "Frankenstein's Mammoth" 590.
22 *Ibid*, 613–618.
23 Jonathan Curci, *The Protection of Biodiversity and Traditional Knowledge in International Law of Intellectual Property* (Cambridge University Press, 2010), 42–43.
24 Antonio Regalado, "How Colossal Biosciences Is Attempting to Own the Woolly Mammoth," *MIT Technology Review*, April 16, 2025.

biodiversity, as well as the context of State sovereignty, as is well established in international law. The CBD, aside from serving as an instrument in managing biodiversity, affirms the principle of sovereign rights of states over their territory and natural resources, including biological resources of flora and fauna; consequently, if any designation of intellectual property rights is granted to a certain group of fauna, as may be possible in this case, exclusive monopoly would be granted and will impede and contradict CBD's overall objectives of conservation, sustainable use, and fair and equitable sharing of benefits.[25] That being said, in an attempt to provide a more comprehensive discussion on this matter, this paper will briefly explore the topic of patenting lifeforms and the presiding juridical considerations.

One of the earliest examples of patented lifeforms in the form of a multicellular organism is the Harvard Mouse, also known as Oncomouse. This exposition is significant for two reasons: one, is that the mouse is a genetically engineered mouse designed for cancer research; two, the mouse was the first case of animal patent in the United States.[26] Regardless of the differing purposes, both Colossal Biosicence's dire wolf and the Harvard Mouse are similar organisms in the sense that they exist due to human intervention and biotechnology invention. Due to its genetic modification and specific research utility, patent applications relating to the Oncomouse were filed and granted in several jurisdictions in addition to the United States' patent, including several European countries, Japan,[27] and, with limitations, Canada. While the Canadian patent of the Oncomouse was ultimately granted in 2003,[28] the Supreme Court of Canada had earlier rejected the patentability of the mouse itself on the ground that higher lifeforms fall outside the legislative purpose of the Canadian Patent Act.[29] In the decision, the Court accepted that the

25 Jonathan Curci, *The Protection of Biodiversity and Traditional Knowledge in International Law of Intellectual Property*, 51–52.

26 6 Carrie E_ Walter, "Beyond the Harvard Mouse: Current Patent Practice and the Necessity of Clear Guidelines in Biotechnology Patent Law," Indiana Law Journal 73_no. 3 (1998): 1029 *Indiana Law Journal* 73, no. 3.

27 Teresa Scassa "A Mouse Is a Mouse Is a Mouse: AComment on the Supreme Court of Canada's Decision on the Harvard Mouse Patent (Harvard College v Canada (Comr of Patents)) *Oxford Universitv Commonwealth Law Journal* 3. no. 1(2003) 255.

28 Johanna K. P. Dennis, "Divergence in Patent Systems: A Discussion of Biotechnology Transgenic Animal Patentability and US Patent System Reform," *International Journal of Private Law* 1, nos. 3–4 (2008): 277.

29 Mark Perry, "Lifeform Patents: The High and the Low," *Journal of International Biotechnology*

genetically engineered oncogene, as a product of human ingenuity, rendered the mouse susceptible to cancer and thereby enabled its use as a research tool for identifying carcinogenic causes and potential treatments.[30] However, although the oncogene and the methods of its insertion constituted patentable inventions resulting from human intervention,[31] this functional and instrumental purpose did not extend patent protection to the animal as a whole, which remained a higher lifeform rather than an invention.[32] The Supreme Court of Canada also identified several considerations in determining whether the Oncomouse met the legislated definition of 'invention' within Canadian Patent Act, such as the degree of inventor control, the extent of human intervention, reproducibility, and underlying legislative policy distinctions concerning higher lifeforms.[33] Using the preceding criteria, the Court determined that only the presence of the oncogene was under the control of the inventor and that other features were not; additionally the Court determined that the Oncomouse was not solely a product of inventiveness; since the Court found that not all of the mice themselves would carry oncogene and so varied in terms of reproducibility; lastly the Court determined that complex lifeform was not patentable due to policy distinction between higher and lower lifeforms.[34] Specifically on the fourth and closing interpretive indicator, as articulated by the Court in its interpretation of the Canadian Patent Act, concerns whether the Act, at the time of its promulgation, was intended to protect unforeseeable innovations.[35] Ultimately, the Court ruled that the definition 'invention' did not extend to

Law no. 1 (2004) 268.

30 *Harvard College v. Canada (Commissioner of Patents)*, 2002 SCC 76, [2002] 4 S.C.R. 45, para. 121.

31 *Ibid*, 122.

32 *Ibid*, 160–161.

33 *Ibid*, 131–135.

34 Teresa Scassa, "A Mouse Is a Mouse Is a Mouse: A Comment on the Supreme Court of Canada's Decision on the Harvard Mouse Patent (Harvard College v Canada (Comr of Patents))," 107.; *Ibid.*, (Nadon J.), noting that although the oncogene was introduced through human intervention, its transmission thereafter occurred only through ordinary breeding governed by Mendelian inheritance, such that the inventor could not reproduce the mammal at will or exercise control over its propagation, thereby negating reproducibility for purposes of patentability of the animal as a whole.

35 *Ibid.*, 10 (Binnie J.), In interpreting the Patent Act, the Court framed the relevant policy inquiry as follows: "The proper question is not whether Parliament intended to include 'oncomice' or 'higher life forms' or biotechnology generally in patent legislation, but whether Parliament intended to protect 'inventions' that were not anticipated at the time of enactment of the Patent Act, or indeed, at any time before the claimed invention."

include higher lifeforms such as the Harvard Mouse within the Canadian Patent Act,[36] and that the patent claims were allowed for the process and rejected for the product.[37] The Court also considered the application of a similar scope of limitation as applied by the Supreme Court of the United States, in that lifeforms that are merely discovered would not be patentable.[38] Furthermore, the Court did not consider ecological values and terms due to the limitation of the scope of the legislated regime.[39] However, unlike the Harvard Mouse, this paper contends that de-extinct organisms have values embedded related to biodiversity, though they are much less evident in practice.

Specific to biodiversity, some of the universally recognized principles which have attained customary or near customary status are: the precautionary principle, the principle of intergenerational equity, and the principle of differentiated responsibilities.[40] Each of these principles relates to biodiversity and is philosophically rooted in preserving the values of nature which are categorized into three separate values: intrinsic, instrumental, and relational.[41] Intrinsic values refer to "values of entities expressed independently of any reference to people as valuers", instrumental values refer to "values of nature entities and other-than-human beings important as means to achieve human ends", whereas relational values refer to "values of meaningful and often reciprocal human relationships – beyond means to an end – with nature and among people through nature".[42] It is highly doubtful if the scientists or the management of Colossal Bioscience considered or deeply pondered each of these values separately to justify or guide them in their efforts. Doctrinally, despite differences of utilization between the Harvard Mouse and the now

36 Scassa, "A Mouse," 105.

37 *Harvard College v. Canada (Commissioner of Patents)*.

38 Scassa, "A Mouse," 108.; *Ibid.*, 131–133 (Nadon J.), noting the preference for minority of opinion expressed in the US Supreme Court in *Diamond v. Chakrabaty* in which patent claim was granted to a "human-made" bacterium used to degrade crude oil due to the fact it did not occur naturally despite dissenting opinion, and that the human intervention element excludes it from mere discovery.

39 *Ibid*, 103 (Rothstein J. A.) noting that patentability of the oncomouse would not prevent further development of the product or other genetically engineered living organisms, patent system addresses disclosure in exchange for rewards.

40 Daniel M. Bodansky, "International Law and the Protection of Biological Diversity," *Vanderbilt Journal of Transnational Law* 28, no. 4 (1995): 627.

41 Austin Himes, "Why Nature Matters: A Systematic Review of Intrinsic, Instrumental, and Relational Values," *BioScience 30* 74, no. 1 (2024): 30.

42 *Ibid.*

de-extinct Aenocyon Dirus, patent applications will not (and evidently, in the case of the Harvard Mouse, did not) ponder biological diversity as a part of their juridical consideration (which arguably may remain to be seen depending on future developments). Additionally, while these definitions mostly serve the scholarly effort of interpretation well enough, it is not sufficient to assert a persuasive philosophical foundation behind the dire wolves' de-extinction in a detailed manner to legally establish ecocentrism. Furthermore, these values cannot be embedded in what arguably is (as of now) a biologically real organism, yet whose existence was recognized only in history (even then its highly debated as the current present living dire wolf organism is not the 'original') and not within biodiversity's dictionary. Meaning, within international fora, a state must either recognize the value of this organism regardless of the time of discovery/invention, or acknowledge the need of conservation due to the inherent need of preservation of the said resources as (it used to be) a part of ecological reality for the principles and valuations to realize and mature into a concrete practice.

Despite the core principles of international environmental law addressing those very values, some legal scholarship (as also mentioned briefly before) has argued that the framework itself possesses inadequacies due to its anthropocentric approach.[43] Coincidentally, if one were to garner insight from theory of natural law under international law,[44] in which law comes from natural moral conscience of humankind, principles under international environmental law, including but not limited to biodiversity, must reflect biocentrism and ecocentrism, which coincides with the rejection of anthropocentrism based on the moral belief that the natural environment possesses value which must be protected regardless of recognition of such value as a part of ecological realism.[45] It is possible that the argued inadequacies of international environmental law stem from anthropocentric utilitarianism approach to the law's environmental ethics,[46] in which considerations and reasonings are

43 Vito De Lucia, "Beyond Anthropocentrism and Ecocentrism: A Biopolitical Reading of Environmental Law," *Journal of Human Rights and the Environment* 8, no. 2 (2017): 184–184.

44 Martti Koskenniemi and Robert McCorquodale, Towards A Theory of International Obligation in Sources of International Law (Routledoe 2016).

45 Onora O'Neill, "Environmenta; Values, Anthropocentrism and Speciesism," *Environmental Values 6*. no. 2 (1997)

46 *Ibid,* 128–129.

made in terms of costs and benefits applicable to humans.[47] Whether that approach is effective in ensuring legal certainty in terms of addressing issues of biodiversity, and subsequently whether incorporation of de-extinction (post Colossal Biosciences' success assessment) may add another degree of complexity is another question entirely. Since effectiveness refers to the factual correspondence between legal rules, situations, and social reality, and therefore the implementation of those rules in respect to that reality,[48] any assessment of foreseeable certainty will need to address the reality of de-extinction and biodiversity simultaneously.

Based on the preceding established analysis, the possible future grant of patent to the de-extinct dire wolves may establish a degree of certainty and confer legally exclusive rights to control economic exploitation through licensing and authorization, but such rights cannot substitute for biodiversity recognition, nor do they generate conservation obligations under ecological terms and values. More importantly, if international biodiversity regulations, such as CBD, Nagoya Protocol, or Cartagena Protocol, did not foresee de-extinction as a future possibility, nor did they anticipate future applicability of eco-centric values to an unprecedented biotechnological breakthrough, questions regarding applicability of established principles become point of contention and deliberation for states to ponder as a part of establishment of ecological realism through proceduralism (i.e. initiation of COP). International environmental law, by architecture, is consensus-oriented and only takes adjudicative form in the event of a breach of consented (arguably universal) principles (e.g., *Trail Smelter*, *Pulp Mills*, *Gabčíkovo-Nagymaros Project*) whereby exemplification of an unacceptable threshold of harm results in a point of litigative dispute. Moreover, despite the criticisms, it is almost self-evident how instruments within international environmental law, whether specific in the regime and normative lens of biodiversity or external to it, possess, integrate, and aspire for eco-centric goals.[49] As such, even more than

47 Sepehr Khajeh Naeeni, *The Utilitarian Approach to Environmental Law: Balancing Costs and Benefits*, 2, no. 1 (2023): 4–5.

48 Enrico Milano, *Unlawful Territorial Situations in International Law: Reconciling Effectiveness, Legality, and Legitimacy*, (Leiden), 2006, 22.

49 See, e.g., *Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration)*, June 16, 1972, U.N. Doc. A/CONF.48/14/Rev.1 (1973), 11 I.L.M. 1416 (1972), Principles 11–14; *Rio Declaration on Environment and Development*, Principles 4, 7–9, & 15;

a legislative reform, what is truly necessary is the willingness and sincerity to acknowledge the importance of biodiversity and incentivizing advancement to, and of, biodiversity as a whole. Otherwise, the current success may only be an astonishing scientific marvel instead of a legal progression through normative development, much less a pure reformative legislative prescription, which are often impractical and cannot address recurring political factors blurring reasonability and rationality. Attributing to the success of de-extinction's long-sought-after endeavor in the scientific community, there is more than what legal nuance may or may not be able to assess with definitive certainty.

The success has undoubtedly been indicated to affect the perception of conservation effort. Past proponents of de-extinction have argued that the driving force, or the 'necessity', is driven by the concept of ecological justice,[50] reestablishment of lost ecological value, or establishment of new ecological value,[51] as well as the notion of de-extinction as a last resort conservation measure.[52] On the other hand, the reality of perception beyond the scholarly and philosophical understanding behind ecological justice is that any solution seeking to address issues or crises of biodiversity, such as the threat of extinctions, should aim to prevent rather than to resurrect.[53] Here, we can see two extremes, and an oscillation between the implied understanding of Jonas' imperative of responsibility applicable to the 'drive' behind scientific progress of de-extinction, and the acknowledgement of inherent values borne by ecological realism's ecocentrism through the concept of ecological justice. In that regard, plausible formulations of legal certainty must first and foremost ensure that there is a place to incorporate or outright exclude de-extinction from the biodiversity framework, values, and all, and treat it as a pure scientific endeavor. Interestingly enough, the 2016 IUCN's guiding principles which were mentioned in the introduction section, listed non-exhaustive

Convention on Biological Diversity, preamble, arts. 1 & 14; *Paris Agreement*, Dec. 12, 2015, U.N. Doc. FCCC/CP/2015/10/Add.1, Decision 1/CP.21, preamble; and United Nations General Assembly, *Transforming our world: the 2030 Agenda for Sustainable Development* (Sustainable Development Goals), G.A. Res. 70/1, U.N. Doc. A/RES/70/1 (Oct. 21, 2015), Goals 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water), and 15 (Life on Land).

50 Ronald Sandler, "The Ethics of Reviving Long Extinct Species," *Conservation Biology* 28, no. 2 (2013): 356–57.

51 *Ibid* 356–357.

52 *Ibid* 357.

53 *Ibid* 356.

disadvantages, risks, and difficulties associated with de-extinction, such as financial and opportunity costs to achieve ecosystem-level goals, uncertainty about species behavior, and other environmental and biological concerns.[54] Clearly, despite Colossal's success, concerns regarding de-extinction prove to be more prevalent and relevant. The fact that Colossal's funding reached a staggering amount of $435 million from investors (spanning across many projects, including the dire wolves),[55] and that the scientific community has yet to be able to evaluate phenotypic data (behavior, genome, etc.) and conduct a full peer review,[56] solidifies the drawbacks and hurdles as exemplified by IUCN in 2016. While currently the developments showing complexity at technical and scientific levels, it seems any inquiries regarding legal certainty of de-extinction in relation to biodiversity's general frame and objectives are considered to be moot. Unless, based on the implied optimism of proponents of de-extinction and ecological justice, a paradigm shift occurs in which anthropocentric utilitarianism is no longer the norm. But is that truly the case?

C. Two Sides of a Coin: Anthropocentrism and Ecocentrism of De-extinction

At first glance, anthropocentrism seems to be an understandably layered, complex, but straightforward concept. From what this paper has attempted to assess in relation to the previous research question, it is the man-centric cost and benefit view in international environmental law, that being (in sum, adapting international environmental law's adoption of its understanding) 'irreversible harm' to the environment is too great of a 'cost' for too little of a 'benefit' – no environment, no resources, no economic return, no sustainability to human life and environment. While biodiversity's frame historically began as an acknowledgement of humanity's lack of comprehensive knowledge, the development has matured into the conclusion, from scientific and legal studies, that biodiversity loss affects human life such that the lack of it imposes significant adverse effects on both the environment and humans themselves. Upon a closer look, philosophical scholarship on

54 "Principles on Creating Proxies of Extinct Species for Conservation Benefit." IUCN SSC, 2016.
55 Josh Saul, "'De-Extinction' Startup With $10 Billion Valuation Revives Dire Wolf," *Bloomberg*, April 7, 2025,
56 Michael I. Jensen-Seaman et al., "The Dire Wolf (Aenocyon Dirus) Resurrection That Wasn't," 5–6.

anthropocentrism deconstructs the states and the forms it may take, to which there are three (apparently): ontological anthropocentrism, epistemological anthropocentrism, and axiological anthropocentrism.[57] As this section continues, these forms will be assessed on their relevance to de-extinction.

For the first form, ontological anthropocentrism is the formulation of the 'classical' anthropocentrism: that being man and his will are at the very center of the world, legal and environmental, and that any agency (and autonomy) of said man is presupposed therein, and the material reality of the world are a collection of passive objects.[58] This scholarship is somewhat synonymous with the concept of speciesism, in which the concept describes difference in treatment based on the moral significance of human animals to non-human animals.[59] The previous section has mentioned how international environmental law has been criticized due to its inadequacies for its anthropocentric approach. One example is the provision contained in the CBD concerning 'biological resources' (Article 2), in which the resources are defined as those with "actual or potential use or value for humanity". Relying on the interpretation method of ordinary meaning (regardless of agreement on the readers' part)[60] for the purposes of determining prevalence of ontological anthropocentrism, the provision arguably places biological resources (such as species within an ecosystem) intrinsic value, in that the resources are in and of themselves have values to the ecosystem; instrumental, they provide utilities to the desired human ends; and relational, they exist reciprocally and complements existence of humans and nature.[61] Additionally, the concept of sustainable use, in the same article, presupposes juridical recognition of components of biological resources, which would then be operationalized through an identification and monitoring process under Article 7. This mechanism specifically functions on the existence of components in ecologically situated contexts subject to observation, interaction, and direct management.[62] Unfortunately, while the

57 Lucia, "Anthropocentrism and Environmental Law" 184.
58 *Ibid.*
59 Frauke Albersmeier, "Speciesism and Speciescentrism," *Ethical Theory and Moral Practice* 54 (2021): 511–27.
60 Brian G. Slocum, *Ordinary Meaning: A Theory of the Most Fundamental Principle of Legal Interpretation* (The University of Chicago Press, 2015).
61 Austin Himes, "Why Nature Matters: A Systematic Review of Intrinsic, Instrumental, and Relational Values."
62 Convention on Biological *Diversity* (Rio de Janeiro, 5 June 1992), Annex I, *Identification and*

dire wolves of Colossal support CBD's biological resources analysis and valuation, they fall outside of biodiversity's framework as organisms whose existence lacks presence in established ecosystems, essentially external to the scope of sustainable use. The species does not fall in any category under CBD's identification and monitoring annex, and its juridical existence depends on future deliberation by CBD's conference of the parties.[63] Even more unfortunate is that the United States, where Colossal is based,[64] is not a contracting party to the CBD.[65] Furthermore, based on the rational choice theory, it is unlikely, in terms of state practice, that any existing contracting party would initiate Article 7 for the purposes of Arts. 8 to 10 unless doing so serves their interests.

Moving on from ontological anthropocentrism is epistemological anthropocentrism. It is best described as an anthropocentric approach in which man is the subject of inquirer of knowledge and that the material world surrounding him is a collection of knowable objects.[66] Whether this is worthy of criticism is up to a debate; is a man (or a woman) not entitled to seek comprehension of the things, material or immaterial, he or she is surrounded (or might be surrounded) in? Previously, this paper has touched briefly on how the development of biodiversity stems from a knowledge impediment. However, the history of knowledge itself suggests that the act of inquiring is rarely neutral. Relying on epistemology scholarship quoting Descartes; "humanity should acquire absolute ownership of the world and control everything: the natural environment, the social world, even the human psyche."[67] This shifts the dogma of comprehension into, for the lack of a better word, dominion. Furthermore, this notion persists when we combine our understanding of how ontological anthropocentrism emphasizes utilitarianism of environmental ethics within international environmental law. Similar

Monitoring, 1760 UNTS 79.

63 Ibid., Article 30, *Adoption and Amendment of Annexes*, 1760 UNTS 79; see also Conference of the parties to the Convention on Biological Diversity, *Rules of Procedure for Meetings of the Conference of the Parties*, UNEP/CBD/COP/1/2 (November 28, 1994), Rules 35–37.

64 Colossal, "Projects, Facts & Statistics." *Colossal*. Last accessed October 9, 2025. https://colossal.com/de-extinction/

65 Benji Jones, "Why the US won't join the single most important treaty to protect nature" *Vox*. May 20, 2021 https://www.vox.com/22434172/us-cbd-treaty-biological-diversity-nature-conservation

66 Lucia, "Anthropocentrism and International Environmental Law," 87.

67 *Ibid*.

epistemological governance prevalence can also be seen in instruments such as CBD,[68] CITES,[69] Cartagena Protocol,[70] and other instruments such as the Nagoya Protocol[71] and the Agreement on the Conservation and Sustainable use of Marine Biological Diversity of Areas beyond National Jurisdiction[72] which sought to classify and catalogue in order to better manage and coalesce it with the interests (unless that 'interest' is expressly or tacitly ecological) of man, or states within the context of conventional international law. Perhaps that is precisely why IUCN was very careful in 2016 to publish a guideline in approaching and viewing de-extinction not as a complementary prospect but a precautionary story. Unsurprisingly, and rather unfortunately, the success of Colossal arguably extends this progress (which is ironic since de-extinction is by no means a scientific or otherwise a legal regression) as their endeavor is an epistemological pursuit in demonstrating knowledge and control over the natural limit of extinction rather than an ecological one. As such, while de-extinction may appear and could potentially be restorative and promotive, it ultimately reaffirms the juxtaposition between the intent behind man's pursuit of knowledge and the natural world man seeks to know.

The final formulation, which coexists with the first two forms, is axiological anthropocentrism. This is an approach which posits that all nonhuman contents exist for man's benefits to serve his interests, and that man is entitled to manipulate the world as he desires.[73] This formulation places the values of the environmental world intrinsically independently of external attributions and only in relation to human beings. Strictly speaking, this is the acknowledged presiding ascription on the formulation of axiological anthropocentrism. However, if one were to take a look into the scholarship

68 Convention on Biological Diversity (Rio de Janeiro, 5 June 1992), Articles 2, 7, 12, and 17, 1760 UNTS 79.

69 Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, D.C., 3 March 1973), Articles II(1) & XV, 993 UNTS 243.

70 Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Montreal, 29 January 2000), Articles 15 & 20, 2226 UNTS 208.

71 Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization to the Convention on Biological Diversity (Nagoya, 29 October 2010), Articles 5 & 17, UNTS vol. 30619.

72 Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (New York, 19 June 2023), Articles 6–11.

73 Lucia "Anthropocentrism and Environmental Law," 184.

on axiology of biodiversity, one that touches yet separates itself from the concept of axiological form of anthropocentrism in environmental ethics, is in and of itself far from simple. Scholarship of axiology of biodiversity places valuations ranging from possessing similarities to the conceptualization of intrinsic and instrumental[74] (arguably anthropocentric in valuations) to metaethical interpretation of values. One adopted philosophical tradition dictates that values influence preferences, aspirations, interests, and norms through the enablement of actions without directly demanding them.[75] Hans Jonas exemplifies this further by pointing to the paradox of values in itself and values as placed and valued by individuals; in that the bond individuals form to certain sets of values does not determine their course of actions, those very actions may very well be at odds with the bonded values, and those individuals are free to transform their values.[76] Conversely, the history of axiology of biodiversity is also both scientifically and politically influenced, between American conservationists' initiative on the National Forum of Biodiversity in 1986, delineating inexistence of 'value-neutral science', to the socio-political metaphorization of the term 'biodiversity' as an epitome of earth's nature endangerment in conservation discourse in 1998 – the resulting outcome is its introduction as a governance concept of nature by conservationists and its eventual elevation to the political realm, in which the valuation placed in 'biodiversity' has been dubbed as an "epistemic-moral hybrid".[77] While this term is not legal, if we were to rely on semasiological consideration of ascription of existing word as a basis and further specifying it into a terminology,[78] the term can be best described as a collection of knowledge of the natural world embedded with metaethical valuations of values such as intrinsic and inherent values (as emphasized and exemplified in the Preamble of the CBD), as well as moral significance from the non-human living world including but not limited to cultural histories shared between the humans

74 Thomas Potthast, "The Values of Biodiversity: Philosophical Considerations Connecting Theory and Practice," in *Concepts and Values in Biodiversity*, eds. Dirk Lanzerath and Minou Friele (London: Routledge, 2014), 135-136.
75 *Ibid,* 135.
76 *Ibid.*
77 *Ibid,* 137.
78 Pius ten Hacken, "Creating Legal Terms: A Linguistic Perspective," *International Journal for the Semiotics of Law* 23, no. 2 (2010): 417.

and the non-humans.[79] While certainly not definitive, this examination has shown that the axiology of biodiversity possesses a specifying characteristic in examining axiological anthropocentrism of biodiversity. Instead of keeping it tied to humans, scholarship on the axiology of biodiversity helps us see the possible valuation of de-extinction, a practice scientifically rooted with values beyond scientific purposes and objectives.

D. Conclusion

With respect to the first posed research question, this paper found that biodiversity under international environmental law provides avenues for embedding valuation and protection. Questions of patent, as may be relevant, especially considering provisions of biotech applications with regard to biological resources in biodiversity's instruments, refer to domestic legal systems, while the general framework conditions its overall objectives, such as sustainable use, fair and equitable benefit sharing through a procedural mechanism and attached obligations. Patentability, where permitted, remains territorially grounded and attributable to a state with jurisdictional competence and sovereign nexus. What biodiversity does not do, however, is to generate juridical recognition of an organism as a protected or regulated component of biodiversity merely by virtue of its technological origin. The Harvard Mouse illustrates this threshold problem: while the underlying technology was legally cognizable, the organism itself was not automatically recognized as an object of holistic legal protection, with recognition instead turning on drafted legislative intent. As opposed to the adjudicative pattern of legal patent regime, biodiversity, as it is with international environmental law in general, is more consensus-oriented; a non-litigative structure further reinforces this gap. Identification, monitoring, and conservation presuppose collective recognition, typically through scientific and policy deliberation within institutional forums, rather than adjudication. As a result, de-extinct organisms may exist as legally cognizable technologies without existing as juridically recognizable components of biodiversity. At present, despite a dense archive of values, principles, and procedural tools, the problem exposed by de-extinction is the absence of collective recognition, willingness,

79 Potthast, "Values of Biodiversity" 141.

and deliberation necessary to utilize those tools in contemplation of this breakthrough.

Turning to the second research question concerning possible anthropocentrism and ecocentrism of de-extinction endeavor on its own, we can see a convergence between an eco-centric orientation and the underlying, yet inevitable, anthropocentric foundation of biodiversity's conceptual and legal frame. In that regard, especially true for the third formation presented, axiological anthropocentrism occupies a liminal position; it neither rejects human-centred valuations nor fully embraces nature's independent moral standing. Rather, it exposes the mutual constitution of both. The success of de-extinction thus represents the culmination of this dynamic: a triumph of knowledge and technology that blurs the boundary between stewardship and dominion. Whether its moral implication is ultimately understood to be anthropocentric, reinforcing humanity's authority over nature, or deemed as eco-centric, reflecting a possible renewed sense of responsibility toward it, remains an open and interpretive question – one that international environmental law, practitioners, and scholars must now contemplate and ponder. In its relation to the first research question, should the endeavor of de-extinction be inherently separated from efforts of biodiversity due to its difficulty and impracticality in achieving ecosystem-level goals (arguably biodiversity in international environmental law faces this problem but it is a matter of another discussion), together or alone with traditional conservation understanding as commonly adopted in biodiversity, one can contently take comfort in the fact that a pure scientific progress can complement an existing, and particularly strived global legal aspiration of biodiversity without it having to be considered as a part of it in entirety or in parts.

Additionally, from the findings, we can see that Colossal's de-extinction has managed to achieve a precedential event best characterized in the following: a scientific success that simultaneously delegitimizes the moral and legal caution that made environmental law possible in the first place. Jonas warned that technological progress requires an ethics of restraint precisely because it extends our power beyond foreseeable consequences. The success has shown that extinction can, in theory and to an extent in practice, be reversed. Possible future deliberations at the international level must then follow suit. It would

that technological progress requires an ethics of restraint precisely because it extends our power beyond foreseeable consequences. The success has shown that extinction can, in theory and to an extent in practice, be reversed. Possible future deliberations at the international level must then follow suit. It would be prudent for international environmental law to define the boundaries of creation and restoration, whether they are eligible for governance in the current paradigm, as well as weighing possibility of developing applicability and re-recognition of the precautionary principle, the principle of intergenerational equity, and the principle of differentiated responsibilities on de-extinction in the context of biodiversity; thus, requiring revisiting moral formation of it. In conclusion, the general examination has shown that the paradox of de-extinction lies in its dual identity: a triumph of knowledge that challenges the very ethical architecture built to restrain humanity's perceived supremacy. It reopens the question of whether environmental law exists to govern nature, or to govern humanity's relation to it. In conclusion, the challenge posed by de-extinction is therefore not of legal invention, but of legal recognition; until collective deliberation occurs, the extensive normative architecture of international environmental law remains present but inactivated.

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