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Frankenstein's Mammoth: Anticipating the Global Legal Framework For De-Extinction

Erin Okuno*

Scientists around the world are actively working toward de-extinction, the concept of bringing extinct species back to life. Before herds of woolly mammoths roam and flocks of passenger pigeons soar once again, the international community needs to consider what should be done about de-extinct species from a legal and policy perspective. In the context of international environmental law, the precautionary principle counsels that the absence of scientific certainty should not be used as an excuse for failing to prevent environmental harm. No global legal framework exists to protect and regulate de-extinct species, and this Article seeks to fill that gap by anticipating how the global legal framework for de-extinction could be structured. The Article recommends that the notions underlying the precautionary principle should be applied to de-extinction and that the role of international treaties and other international agreements should be considered to determine how they will or should apply to de-extinct species. The Article explains the concepts of extinction and de-extinction, reviews relevant international treaties and agreements, and analyzes how those treaties and agreements might affect de-extinct species as objects of trade, as migratory species, as biodiversity, as genetically modified organisms, and as intellectual property. The Article provides suggestions about how the treaties and the international legal framework could be modified to address de-extinct species more directly. Regardless of ongoing moral and ethical debates about de-extinction, the Article concludes that the international community must begin to contemplate

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how de-extinct species will be regulated and protected under existing and prospective international laws and policies.

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INTRODUCTION

Dr. Frankenstein is at it again. Only this time, he is not creating a man (or a monster). He is creating a mammoth.

Scientists around the world are actively working toward de-extinction, the concept of bringing extinct species back to life. It is not clear how quickly de-extinction might be achieved, but many believe that it soon will be possible to resurrect extinct species such as the woolly mammoth, the passenger pigeon, and others. Herds of woolly mammoths and flocks of passenger pigeons (or close approximations) may one day be revived and reintroduced into the wild. Like a phoenix rising from the ashes, these once-extinct species could return to their earthly form—and soon.

Not surprisingly, the ethical and moral implications of de-extinction have been debated intensely over the last several years.¹ But regardless of this seemingly endless ethical debate, the science of de-extinction is moving forward. Inevitably, de-extinction will have numerous legal implications—locally, nationally, and internationally. To a certain extent, existing laws, regulations, and policies may be applicable to de-extinct species; however, in many instances, the legal frameworks will need to be modified to regulate the introduction of de-extinct species into the environment and to ensure that de-extinct species are adequately protected. Measures also should be taken to ensure that humans and the environment are protected from de-extinct species. Rather than waiting until a de-extinct species is at risk of becoming extinct again or a de-extinct species has caused serious damage to the environment, it is important to anticipate what legal and policy changes are needed to address the novel issues that will arise with de-extinct species.

Because de-extinction is still in its infancy, no comprehensive international legal framework for de-extinction currently exists. This Article

1. See *infra* Part I(B).

seeks to fill that void by beginning to anticipate the global legal framework for de-extinction. The Article recommends that the concepts underlying the precautionary principle should be applied in the context of de-extinction, and it suggests that the role of international treaties should be considered to determine how to control and protect de-extinct species. These treaties include the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Convention on the Conservation of Migratory Species of Wild Animals, the Convention on Biological Diversity, the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, the Paris Convention for the Protection of Industrial Property, the Patent Cooperation Treaty, the Patent Law Treaty, and other international agreements.

Part I of this Article discusses the concepts and legal effects of extinction and de-extinction, and offers an overview of the ongoing ethical debate about de-extinction. In Part II, the Article considers several international treaties and explains how these treaties might apply (or not) to protect and regulate de-extinct species through trade restrictions, as migratory species, as biodiversity, as genetically modified organisms, and as intellectual property. Next, Part III discusses the precautionary principle and its role in some international treaties. The precautionary principle provides that the absence of scientific certainty should not be used as an excuse for failing to prevent environmental harm, and this Article suggests that a precautionary-type approach should be applied to address de-extinction. Part IV proposes various ways in which the international legal framework could be altered to control and safeguard de-extinct species. Finally, Part V concludes that regardless of the moral and ethical debates surrounding de-extinction, the international community should take a precautionary approach and determine how de-extinct species should be regulated and protected under existing and new international laws and policies.

I. EXTINCTION AND DE-EXTINCTION: DEFINITIONS AND LEGAL IMPLICATIONS OF THE FALL AND RISE OF SPECIES

In order to understand the concept of de-extinction, it is useful to consider what it means for a species to be extinct. This Part begins with a discussion of extinction, its legal implications, and the ways in which a species is declared extinct. It then provides information about the concept of de-extinction, its relatively short history, and the processes by which de-extinction might soon occur.

A. *Extinction: The Irreversible End of a Species—Or Is It?*

Although scientists do not agree about the exact rates, species extinction rates are much higher now than the background extinction rates that would exist without humans—some studies suggest at least 1000 times higher.² Other

2. See, e.g., Jurriaan M. De Vos et al., *Estimating the Normal Background Rate of Species Extinction*, 29 CONSERVATION BIOLOGY 452, 460 (2015) (stating that extinction rates are currently

studies estimate that species extinction rates are not nearly as high and are less than 100 times the background extinction rates.³ Regardless of the actual rates, most scientists agree that humans have increased extinction rates, especially over the last several hundred years.⁴ The three main causes of human-associated (or, perhaps more accurately, human-driven) extinctions are the over-exploitation of species, destruction of their habitats, and the introduction of alien species.⁵ Extinctions—especially human-driven or human-influenced extinctions—are significant; in addition to the negative moral implications, extinctions can have drastic ecological consequences, such as increasing or decreasing other species' populations, contributing to coextinctions of other species, and disrupting ecosystem functions.⁶

Despite their sometimes-dire consequences, extinctions are natural and fairly common, and the Earth has already experienced five mass extinctions, at which times the Earth is estimated to have lost over 75 percent of its species.⁷ Many scientists believe that the Earth could be moving rapidly toward a sixth mass extinction caused largely by human activity.⁸ Some have posited that if we do not address current threats to species, this sixth mass extinction could occur in the next few centuries.⁹ Even if humans do not end up causing the

around 1000 times greater than background rates and that future rates may be 10,000 times greater); S. L. Pimm et al., *The Biodiversity of Species and Their Rates of Extinction, Distribution, and Protection*, 344 *SCIENCE* 987, 989 (2014) (estimating that extinction rates are currently 1000 times higher than background extinction rates); MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: BIODIVERSITY SYNTHESIS 3–4, 43–44 (2005), <http://www.millenniumassessment.org/documents/document.354.aspx.pdf> (noting that current extinction rates are as much as 1000 times higher); see also Robert M. May, *Q&A: Extinctions and the Impact of Homo Sapiens*, *BMC BIOLOGY*, May 2012, at 2, <http://www.biomedcentral.com/content/pdf/1741-7007-10-106.pdf> (suggesting that extinction rates could have increased “by a factor 1,000 to 10,000”). The background extinction rate is estimated to be 0.1 E/MSY (“extinctions per million species per year”). De Vos et al., *supra* note 2, at 454, 460; Pimm et al., *supra* note 2, at 989.

3. See, e.g., Gerardo Ceballos et al., *Accelerated Modern Human-Induced Species Losses: Entering the Sixth Mass Extinction*, *SCI. ADVANCES*, June 2015, at 1, 2 (estimating that vertebrate extinction rates are between 8 and 100 times higher than background rates).

4. See, e.g., *id.* at 1; May, *supra* note 2, at 2; Navjot S. Sodhi et al., *Causes and Consequences of Species Extinctions*, in *THE PRINCETON GUIDE TO ECOLOGY* 514, 518–19 (Simon A. Levin et al. eds., 2014), http://press.princeton.edu/chapters/s5_8879.pdf; Stuart L. Pimm et al., *The Future of Biodiversity*, 269 *SCIENCE* 347, 347 (1995).

5. May, *supra* note 2, at 1. Some categorize the causes into four groups (“habitat loss, direct take, pollution . . . and introduced species”), which are known as the “Four Horsemen of modern extinctions.” Joel Greenberg, *A Feathered River Across the Sky: The Passenger Pigeon’s Flight to Extinction* 202 (2014).

6. Sodhi et al., *supra* note 4, at 516, 519. One suggested coextinction is that of the feather louse and the passenger pigeon. *Id.* at 519.

7. Anthony D. Barnosky et al., *Has the Earth’s Sixth Mass Extinction Already Arrived?*, 471 *NATURE* 51, 51 (2011). The five mass extinctions occurred “near the end of the Ordovician, Devonian, Permian, Triassic and Cretaceous Periods.” *Id.*; see also Beth Shapiro, *How to Clone a Mammoth: The Science of De-Extinction* 6 (2015) (explaining that extinctions are natural). The Cretaceous period ended approximately 65 million years ago. Ben Waggoner et al., *The Cretaceous Period*, UNIVERSITY OF CALIFORNIA MUSEUM OF PALEONTOLOGY (June 15, 2011), <http://www.ucmp.berkeley.edu/mesozoic/cretaceous/cretaceous.php>.

8. Barnosky et al., *supra* note 7, at 51; Greenberg, *supra* note 5, at 201.

9. Barnosky et al., *supra* note 7, at 51.

sixth mass extinction, species are still going extinct at alarmingly high rates,¹⁰ primarily due to human activities.

In common parlance, “extinction” is defined as “the state or situation that results when something (such as a plant or animal species) has died out completely.”¹¹ Functionally, however, extinction is not that simple. For example, a species that still exists may be considered extinct only in the wild or only in a certain geographical area.¹² There does not appear to be a separate legal definition of “extinction,” at least as the term relates to the extinction of a species,¹³ but species extinction (or the prospect of species extinction) has serious legal implications.

In the United States, species extinction is implicated by the federal Endangered Species Act (ESA).¹⁴ As noted in the ESA, “various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation.”¹⁵ The ESA defines an “endangered species” as “any species which is in danger of *extinction* throughout all or a significant portion of its range.”¹⁶ Extinction essentially drives the ESA—determining whether a plant or animal species is in danger of extinction and protecting species from extinction are the ESA’s main purposes.¹⁷

ESA regulations provide three reasons to delist or remove a species from the endangered species list: the first is extinction.¹⁸ Determining that a species is extinct has serious legal consequences because the ESA does not protect

10. See Pimm et al., *supra* note 2, at 987, 988. One notable recent species extinction is that of the western black rhino, which was declared extinct in 2013. See Matthew Knight, *Western Black Rhino Declared Extinct*, CNN (Nov. 6, 2013, 11:36 AM), <http://www.cnn.com/2011/11/10/world/africa/rhino-extinct-species-report/>.

11. *Extinction*, MERRIAM-WEBSTER.COM, <http://www.merriam-webster.com/dictionary/extinction> (last visited Feb. 6, 2016).

12. See, e.g., IUCN SPECIES SURVIVAL COMM’N, IUCN RED LIST CATEGORIES AND CRITERIA 14 (2d ed. 2012), http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf (“A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range.”).

13. Another definition of “extinct” is “[n]o longer in existence or use.” *Extinct*, BLACK’S LAW DICTIONARY (10th ed. 2014). The term is used in certain other legal contexts. For example, in the area of wills and estates, it is part of the doctrine of “ademption,” which “is the extinction, alienation, withdrawal, or satisfaction of a legacy or devise by some act of the testator by which an intention to revoke is indicated.” *Koulogeorge v. Campbell*, 983 N.E.2d 1066, 1074 (Ill. Ct. App. 2012). As it relates to a guaranty, “extinction of the principal obligation[] discharges the obligation of the guarantor.” *Lyon Fin. Servs., Inc. v. Bella Medica Laser Ctr., Inc.*, 738 F. Supp. 2d 856, 862 (N.D. Ill. 2010) (citations omitted). There are also questions as to how to define a species and the effect that de-extinction might have on how a species is defined. David Biello, *Efforts to Resuscitate Extinct Species May Spawn a New Era of the Hybrid*, SCIENTIFIC AMERICAN (Mar. 26, 2013), <http://www.scientificamerican.com/article/lost-species-revived-from-dna-and-restored-to-nature/>.

14. Endangered Species Act, 16 U.S.C. §§ 1531–1544 (2012).

15. § 1531(a)(1).

16. § 1532(6) (emphasis added). The definition excludes certain insects. *Id.*

17. See § 1531.

18. Revisions of Endangered and Threatened Species Lists, 50 C.F.R. § 424.11(d)(1) (2015). The other two reasons for delisting are that the species has recovered or that the original data upon which the species was classified as endangered or threatened was erroneous. § 424.11(d)(2)–(3).

extinct species.¹⁹ If a species is extinct, the U.S. Fish and Wildlife Service or NOAA Fisheries will first declare that species to be extinct before proposing that the species be removed from the endangered species list.²⁰ The agencies must review the species' status, and a delisting "must be supported by the best scientific and commercial data available."²¹ Interestingly, as the U.S. Fish and Wildlife Service has noted, "extinction cannot be demonstrated with absolute certainty (*i.e.*, it is a probabilistic determination)."²² The timing of a declaration of extinction is critical; prematurely proclaiming that a species is extinct may actually contribute to its extinction because people might stop trying to conserve the species if they think it is already extinct.²³ In the case of delisting under the ESA, the regulations clarify that "a sufficient period of time must be allowed before delisting to indicate clearly that the species is extinct."²⁴

Globally, no specific person or group has the ultimate authority to pronounce a species extinct, but the International Union for Conservation of Nature (IUCN) is the primary international entity that declares species extinctions.²⁵ The IUCN maintains the IUCN Red List of Threatened Species (Red List), which is described as "the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species."²⁶ The IUCN Species Survival Commission carries out most of the assessments that are used in the Red List.²⁷ Among other things, the Red List categorizes the status of species (including identifying species that are at risk of going extinct),²⁸ and a species may be declared extinct on the Red List.²⁹ According to the Species Survival Commission, "[a] taxon³⁰ is [e]xtinct when there is no reasonable doubt that the last individual has died. A taxon is presumed [e]xtinct

19. See generally § 424.11(d)(1) (explaining that a species can be delisted due to its extinction).

20. See, e.g., Endangered and Threatened Wildlife and Plants: Removing Eastern Puma (=Cougar) from the Federal List of Endangered and Threatened Wildlife, 80 Fed. Reg. 34,595, 34,604 (June 17, 2015) (to be codified 50 C.F.R. pt. 17) ("determin[ing] that the subspecies Puma (=Felis) concolor cougar [the eastern cougar] is extinct" and proposing that it be delisted).

21. § 424.11(d).

22. 80 Fed. Reg. at 34,600.

23. Rachel Nuwer, *Endangered Species: The Last Animals of Their Kind*, BBC FUTURE (May 9, 2014), <http://www.bbc.com/future/story/20140509-whats-the-worlds-rarest-animal>. Some refer to this as the "Romeo effect." *Id.*

24. § 424.11(d)(1).

25. See Brian Palmer, *Scientists Work Hard to Avoid Declaring a Species Extinct*, WASH. POST (Feb. 21, 2011, 1:44 PM), <http://www.washingtonpost.com/wp-dyn/content/article/2011/02/21/AR2011022102611.html>; Int'l Union for Conservation of Nature & Natural Resources, *About, THE IUCN RED LIST OF THREATENED SPECIES*, <http://www.iucnredlist.org/about> (last visited Feb. 6, 2016).

26. Int'l Union for Conservation of Nature & Natural Resources, *Overview of the IUCN Red List, THE IUCN RED LIST OF THREATENED SPECIES*, <http://www.iucnredlist.org/about/overview> (last visited Aug. 6, 2016).

27. Int'l Union for Conservation of Nature & Natural Resources, *Assessment Process, THE IUCN RED LIST OF THREATENED SPECIES*, <http://www.iucnredlist.org/technical-documents/assessment-process> (last visited Aug. 6, 2016).

28. Int'l Union for Conservation of Nature & Natural Resources, *supra* note 26.

29. See IUCN SPECIES SURVIVAL COMM'N, *supra* note 12, at 14.

30. The Species Survival Commission uses "the term 'taxon' . . . for convenience, and [the term] may represent species or lower taxonomic levels." *Id.* at 4.

when exhaustive surveys in known and/or expected habitat, at appropriate times . . . , throughout its historic range have failed to record an individual.”³¹ To ensure accurate assessments, the Species Survival Commission recommends that biologists complete surveys over an appropriate time frame based on the taxon’s life cycle and form.³²

B. *De-extinction: A Possible Antidote to Death*

A declaration of extinction is not absolute,³³ and occasionally, species that were once thought to be extinct are found alive—so-called “Lazarus species.”³⁴ For example, scientists recently rediscovered a tree frog, *Frankixalus jerdonii*, in India that was thought to have been extinct for almost 150 years.³⁵ But what if a species that is truly extinct could be brought back to life? Enter the emerging concept of de-extinction.³⁶ De-extinction is “the process of resurrecting species that have died out, or gone extinct.”³⁷ There is a relative dearth of legal scholarship on the topic of de-extinction,³⁸ but the concept has

31. *Id.* at 14.

32. *See id.*

33. Endangered and Threatened Wildlife and Plants: Removing Eastern Puma (=Cougar) from the Federal List of Endangered and Threatened Wildlife, 80 Fed. Reg. 34,595, 34,600 (June 17, 2015) (to be codified 50 C.F.R. pt. 17).

34. Erik Meijaard & Vincent Nijman, *Secrecy Considerations for Conserving Lazarus Species*, 175 BIOLOGICAL CONSERVATION 21, 22 (2014); Christine Dell’Amore, ‘Extinct’ Bird Rediscovered in Myanmar, *Surprising Scientists*, NAT’L GEOGRAPHIC (Mar. 5, 2015), <http://news.nationalgeographic.com/news/2015/03/150305-birds-extinct-rediscovered-myanmar-burma-animals-science/>; Louise Gentle, *Meet the Lazarus Creatures—Six Species We Thought Were Extinct, but Aren’t*, IFLSCIENCE! (June 11, 2015, 6:21 PM), <http://www.iflscience.com/plants-and-animals/meet-lazarus-creatures-six-species-we-thought-were-extinct-aren-t>.

35. Josh Hafner, *Strange Frog, Thought Extinct since 1870, Found in India*, USA TODAY (Jan. 22, 2016, 6:49 PM), <http://www.usatoday.com/story/news/nation-now/2016/01/22/strange-frog-thought-extinct-since-1870-found-india/79179924/>.

36. For a comprehensive explanation and analysis of de-extinction, see generally SHAPIRO, *supra* note 7.

37. Kara Rogers, *De-Extinction*, ENCYCLOPAEDIA BRITANNICA, <http://www.britannica.com/science/de-extinction> (last updated May 20, 2016). De-extinction is also known as “resurrection biology” or “genetic rescue.” *Id.*; Revive & Restore, *What “Genetic Rescue” Means*, THE LONG NOW FOUNDATION, <http://reviverestore.org/what-we-do/genetic-rescue/> (last visited Oct. 10, 2015). Other terms for de-extinction include resurrection, re-creation, resuscitation, or reviving. Markku Oksanen & Helena Siipi, *Introduction: Towards a Philosophy of Resurrection Science*, in THE ETHICS OF ANIMAL RE-CREATION AND MODIFICATION 1, 3 (Markku Oksanen & Helena Siipi eds., 2014). Some people make a distinction between cloning recently extinct species (de-extinction) and reviving species that went extinct decades or more ago (deep de-extinction). *See, e.g.*, Ronald Sandler, *The Ethics of Reviving Long Extinct Species*, 28 CONSERVATION BIOLOGY 354, 355 (2014). This Article does not make that distinction.

38. Recently published legal articles that address de-extinction include Alejandro E. Camacho, *Going the Way of the Dodo: De-Extinction, Dualisms, and Reframing Conservation*, 92 WASH. U. L. REV. 849 (2015); Norman F. Carlin, Ilan Wurman & Tamara Zakim, *How to Permit Your Mammoth: Some Legal Implications of “De-Extinction”*, 33 STAN. ENVTL. L.J. 3 (2013); Miriam Ricanne Swedlow, *The Woolly Mammoth in the Room: The Patentability of Animals Brought Back from Extinction Through Cloning and Genetic Engineering*, 11 WASH. J. L. TECH. & ARTS 183 (2015); *see also* Jon Hoekstra, *Networking Nature: How Technology Is Transforming Conservation*, 93 FOREIGN AFF. 80 (2014) (briefly noting de-extinction and considering how technologies, including synthetic

been quite popular in the media³⁹ and scientific literature⁴⁰ over the last few years.

As one would expect, the concept of de-extinction is highly controversial.⁴¹ One argument in favor of de-extinction is that reviving species that humans led to extinction is a matter of justice,⁴² but others argue that the concept is unnatural and hubristic.⁴³ Some suggest that de-extinction may

biology and biotechnology, might affect conservation); SHAPIRO, *supra* note 7, at 162 (noting that “legal guidelines [will] be required to manage introduced populations and mitigate any potential negative consequences of reintroduction”); Chris Slack, Note, Association for Molecular Pathology v. Myriad Genetics, Inc.: *What Are the Effects on Cloning Animals and Agriculture Now That cDNA Is Patentable*, 19 *DRAKE J. AGRIC. L.* 347 (2014) (discussing whether cloned animals are patentable and assessing how the United States Supreme Court’s decision in *Association for Molecular Pathology v. Myriad Genetics, Inc.* will affect cloned extinct animals and agriculture).

39. See, e.g., Stewart Brand, *The Case for De-Extinction: Why We Should Bring Back the Woolly Mammoth*, *YALE ENV’T* 360 (Jan. 13, 2014), http://e360.yale.edu/feature/the_case_for_de-extinction_why_we_should_bring_back_the_woolly_mammoth/2721/; *Is “De-Extinction” Possible?*, *BBC FUTURE* (June 19, 2015), <http://www.bbc.com/future/story/20150619-is-de-extinction-possible>; Sarah Kaplan, *‘De-Extinction’ of the Woolly Mammoth: A Step Closer*, *WASH. POST* (Apr. 24, 2015), <http://www.washingtonpost.com/news/morning-mix/wp/2015/04/24/de-extinction-and-the-woolly-mammoth-genome/>; Liza Lester, *De-Extinction, a Risky Ecological Experiment*, *ECOLOGICAL SOC’Y OF AM.* (Feb. 19, 2016), <http://www.esa.org/esablog/guest-posts/de-extinction-a-risky-ecological-experiment/>; Elizabeth Quill, *These Are the Extinct Animals We Can, and Should, Resurrect*, *SMITHSONIAN* (May 2015), <http://www.smithsonianmag.com/science-nature/these-are-extinct-animals-we-can-should-resurrect-180954955/?no-ist>; Harry Smith et al., *Scientists Want to Bring Back Woolly Mammoths—But Why?*, *NBC NEWS* (May 22, 2016, 1:45 PM), <http://www.nbcnews.com/news/world/scientists-want-bring-back-woolly-mammoths-why-n575581>; Carl Zimmer, *Bringing Them Back to Life*, *NAT’L GEOGRAPHIC* (Apr. 2013), <http://ngm.nationalgeographic.com/2013/04/125-species-revival/zimmer-text>. These are just a few of the numerous articles in the media that have discussed de-extinction.

40. See, e.g., William M. Adams, *Geographies of Conservation I: De-Extinction and Precision Conservation*, in *PROGRESS IN HUM. GEOGRAPHY* 1 (May 18, 2016), <http://phg.sagepub.com/content/early/2016/05/17/0309132516646641.full.pdf+html>; Carrie Friese & Claire Marris, *Making De-Extinction Mundane?*, *PLOS BIOLOGY*, Mar. 2014, at 1, <http://www.plosbiology.org/article/doi/10.1371/journal.pbio.1001825&representation=PDF>; Dolly Jørgensen, *Reintroduction and De-Extinction*, 63 *BIOSCIENCE* 719 (2013); Michael J.L. Peers et al., *De-Extinction Potential Under Climate Change: Extensive Mismatch Between Historic and Future Habitat Suitability for Three Candidate Birds*, 197 *BIOLOGICAL CONSERVATION* 164 (2016); Jacob S. Sherkow & Henry T. Greely, *What If Extinction Is Not Forever?*, 340 *SCIENCE* 32 (2013); see also Philip J. Seddon et al., *Reintroducing Resurrected Species: Selecting DeExtinction Candidates*, 29 *TRENDS IN ECOLOGY & EVOLUTION* 140 (2014) (using the IUCN Guidelines on Reintroduction and Other Conservation Translocations to consider which species would be appropriate de-extinction candidates). The IUCN Species Survival Commission has begun drafting “Guiding Principles on Species De-Extinction.” *INT’L UNION FOR CONSERVATION OF NATURE, 2014 ANNUAL REPORT OF THE SPECIES SURVIVAL COMMISSION AND THE GLOBAL SPECIES PROGRAMME* 8 (2015), <https://portals.iucn.org/library/sites/library/files/documents/2015-024.pdf>.

41. See, e.g., Sandler, *supra* note 37 (assessing ethical arguments in favor of, and against, de-extinction); Shlomo Cohen, *The Ethics of De-Extinction*, 8 *NANOETHICS* 165 (2014) (providing an overview of the ethical issues); see also Kate E. Jones, *From Dinosaurs to Dodos: Who Could and Should We De-Extinct?*, 6 *FRONTIERS OF BIOGEOGRAPHY* 20, 22 (2014) (suggesting alternative uses of de-extinction technology and mentioning some of the ethical concerns); Lucia Martinelli et al., *De-Extinction: A Novel and Remarkable Case of Bio-Objectification*, 55 *CROATIAN MED. J.* 423, 424 (2014) (noting that de-extinction is controversial and considering it a case of bio-objectification).

42. Sandler, *supra* note 37, at 355–56.

43. *Id.* at 357–59.

restore the ecological, instrumental, and intrinsic value that was lost when a species went extinct⁴⁴ and that de-extinction might be used to help restore biodiversity and increase ecosystems' resilience,⁴⁵ yet others worry that revived species may cause serious ecological or human health problems and that animals who are involved in the de-extinction process may suffer.⁴⁶ The process of de-extinction could improve scientific knowledge and technology, and de-extinction may act as a last resort conservation tool (sort of like an insurance policy for endangered species).⁴⁷ The science and technology of de-extinction efforts also could be used to help existing endangered species populations recover.⁴⁸ Some are concerned, however, that de-extinction will divert financial and other resources away from existing conservation and management programs.⁴⁹

On one hand, the concept of de-extinction is intriguing and exciting, and it eventually could contribute in positive and significant ways to the science and technology used for biodiversity conservation. On the other hand, trepidations about animal welfare and potential negative effects of introducing a de-extinct species into the environment are certainly compelling. The purpose of this Article, however, is not to enter the fray regarding whether de-extinction is morally or ethically defensible. There are many controversial issues (such as abortion) for which a legal framework has evolved despite the lack of consensus about what is ethically appropriate. De-extinction will be no exception. The ethical debate surrounding de-extinction undoubtedly will continue, but regardless of the ethical issues, those pursuing de-extinction will proceed.⁵⁰ As such, the laws and policies that could regulate and protect de-extinct species need to be considered now.

De-extinction is not something that will take place tomorrow, but scientists are making major advancements, and eventual success appears inevitable.⁵¹ De-extinction almost became a reality in 2003, when scientists

44. *Id.* at 356–57.

45. Hoekstra, *supra* note 38, at 86 (paraphrasing Stewart Brand).

46. Sandler, *supra* note 37, at 357–58. Similar concerns were also raised about cloning. *Id.*

47. *Id.* at 355–57.

48. See, e.g., David Biello, *De-Extinction in Action: Scientists Consider a Plan to Reinject Long-Gone DNA into the Black-Footed Ferret Population*, SCIENTIFIC AMERICAN (Aug. 1, 2016), <http://www.scientificamerican.com/article/de-extinction-in-action-scientists-consider-a-plan-to-reinject-long-gone-dna-into-the-black-footed-ferret-population/#> (discussing a possible plan to help the black-footed ferret); Jacob Kushner, *Biologists Could Soon Resurrect Extinct Species. But Should They?*, WIRED (Nov. 9, 2015, 10:00 AM), <http://www.wired.com/2015/11/biologists-could-soon-resurrect-extinct-species-but-should-they/> (explaining how scientists are trying to save the Northern white rhinoceros).

49. Friese & Marris, *supra* note 40, at 1. These are some of the main ethical considerations regarding de-extinction, but there are undoubtedly many other arguments on the topic.

50. This Article assumes that the ethical debate will not end in a moratorium (either temporary or permanent) on de-extinction research because an end to the research seems unlikely. The slight possibility of such a moratorium should not prevent the international community from planning for the future of de-extinction.

51. C. Josh Donlan, *De-Extinction in a Crisis Discipline*, 6 FRONTIERS OF BIOGEOGRAPHY 25 (2014) (stating that de-extinction “is likely to become commonplace—sooner rather than later” due to

came close to reviving the extinct bucardo (Pyrenean ibex), a type of wild goat.⁵² Scientists implanted genetically modified eggs into surrogate mothers, and one mother carried a baby to term.⁵³ Unfortunately, the baby bucardo clone died shortly after her birth due to a lung defect.⁵⁴ To date, this attempt was as close as scientists have been able to get to true de-extinction,⁵⁵ but many scientists are still diligently pursuing the effort.⁵⁶ Candidate species for de-extinction include the passenger pigeon and the woolly mammoth, as well as the Steller's sea cow, the Xerces blue butterfly, the northern and southern gastric brooding frogs, the auroch, and others.⁵⁷

the increasing rate at which technology is advancing); Revive & Restore, *Frequently Asked Questions*, THE LONG NOW FOUNDATION, <http://reviverestore.org/faq/> (last visited Aug. 6, 2016) (suggesting that most of the de-extinction projects will probably take decades but noting that major milestones will be reached this decade).

52. Zimmer, *supra* note 39.

53. *Id.*

54. *Id.*

55. *Id.*; see also GEORGE CHURCH & ED REGIS, REGENESIS: HOW SYNTHETIC BIOLOGY WILL REINVENT NATURE AND OURSELVES 133–36 (2012) (describing the resurrection of the baby bucardo); SHAPIRO, *supra* note 7, at 7–8, 142–44 (also describing the resurrection of the bucardo).

56. One such group is Revive & Restore, whose “mission is to enhance biodiversity through the genetic rescue of endangered and extinct species.” Revive & Restore, *What We Do*, THE LONG NOW FOUNDATION, <http://reviverestore.org/about-us/mission/> (last visited Aug. 5, 2016).

57. Revive & Restore, *Candidate Species for De-Extinction*, THE LONG NOW FOUNDATION, <http://reviverestore.org/candidates/> (last visited Feb. 6, 2016); see also Stewart Brand, *2015 Year End Report by Stewart Brand*, THE LONG NOW FOUNDATION (Dec. 29, 2015), <http://reviverestore.org/2015-year-end-report/>. The Revive & Restore website has a criteria checklist to illustrate why a particular species may or may not be a good candidate for de-extinction. Revive & Restore, *Criteria Checklist*, THE LONG NOW FOUNDATION, <http://reviverestore.org/species/> (last visited Aug. 5, 2016). The passenger pigeon is the flagship species of the Revive & Restore team. *Revive & Restore*, THE LONG NOW FOUNDATION, <http://reviverestore.org> (last visited Feb. 6, 2016). Passenger pigeons once numbered as many as three to five billion, but humans drove them to extinction by the early 1900s. Lesley Evans Ogden, *Extinction Is Forever. . . Or Is It?*, 64 *BIOSCIENCE* 469, 469 (2014); see also GREENBERG, *supra* note 5, at 1 (describing the passenger pigeon as “the most abundant bird on the continent, if not the planet”). Martha, the last known living passenger pigeon, died in 1914. William Souder, *100 Years after Her Death, Martha, the Last Passenger Pigeon, Still Resonates*, *SMITHSONIAN MAGAZINE* (Sept. 2014), <http://www.smithsonianmag.com/smithsonian-institution/100-years-after-death-martha-last-passenger-pigeon-still-resonates-180952445/?no-ist>. For a thorough and interesting account of the unfortunate plight of the passenger pigeon, see generally GREENBERG, *supra* note 5. To read more about de-extinction, the passenger pigeon, and other extinct or nearly extinct species, see generally M. R. O'CONNOR, *RESURRECTION SCIENCE: CONSERVATION, DE-EXTINCTION AND THE PRECARIOUS FUTURE OF WILD THINGS* (2015); SHAPIRO, *supra* note 7. Research teams in the United States and in Russia are working to revive the woolly mammoth. Revive & Restore, *Woolly Mammoth Revival*, THE LONG NOW FOUNDATION, <http://reviverestore.org/projects/woolly-mammoth/> (last visited Feb. 6, 2016); *Russia: New Laboratory to Study Mammoth Cloning*, *BBC NEWS* (Sept. 1, 2015), <http://www.bbc.com/news/blogs-news-from-elsewhere-34113706>. Australian scientists who are members of the Lazarus Project have been working to bring back the extinct northern and southern gastric brooding frogs and have already been able to create embryos of the frogs. Zimmer, *supra* note 39. The Tauros Foundation has been using selective back-breeding to revive the extinct auroch, a large ox that lived in Europe and Asia. Revive & Restore, *De-Extinction Projects, Techniques, and Ethics*, THE LONG NOW FOUNDATION, <http://reviverestore.org/1stde-extinction/> (last visited Aug. 5, 2016). Scientific research teams are working on reviving other species as well. See, e.g., Revive & Restore, *Heath Hen Revival Project*, THE LONG NOW FOUNDATION, <http://reviverestore.org/projects/heath-hen-project/> (last visited Feb. 6, 2016) (focusing on resurrecting and restoring the heath hen to New England). The Quagga Project has been working to resurrect the quagga since 1987. *The Quagga*

There are several methods that have been proposed for de-extinction, including cloning, genetic engineering, and selective back-breeding or mating.⁵⁸ Cloning involves inserting a nucleus from the extinct animal's cells into a host animal's unfertilized egg cell and then implanting the cell into a surrogate.⁵⁹ Through genetic engineering, scientists fill gaps in the incomplete genetic sequence of an extinct species using DNA fragments from a closely related living species.⁶⁰ Finally, for selective back-breeding or strategic mating, scientists identify certain traits and selectively breed close living relatives of an extinct species until the living specimens begin to resemble the extinct species.⁶¹ Some species may be revived by a combination of these methods.⁶²

No de-extinction technique could create living specimens that are genetically identical to the extinct species, but the revived specimens could be close.⁶³ The appropriate method or methods of de-extinction and likelihood of success will vary based on certain characteristics of the species. Cloning likely will be limited to species that have gone extinct more recently and have well preserved cells available.⁶⁴ Genetic engineering, on the other hand, may be a viable method to revive a broad range of species (although scientists cannot resurrect species that went extinct as long ago as dinosaurs).⁶⁵ Generally, the less time that a species has been extinct, the higher the likelihood that the species could be brought back, and it may be easier to resurrect species that have close living relatives.⁶⁶ De-extinction also may be more feasible for extinct species that have simpler genomic sequences, such as invertebrates.⁶⁷

Although the exact methodology by which de-extinction will proceed is not clear, as scientists make progress, countries will need to address de-extinction in their national legislation and policies. Plants and animals, however, do not respect national boundaries. Therefore, the international community should consider the legal and policy issues surrounding de-extinction and the preservation of species.

Revival, THE QUAGGA PROJECT S. AFR., <http://www.quaggaproject.org/> (last visited Feb. 10, 2016); see also Oksanen & Siipi, *supra* note 37, at 5.

58. Oksanen & Siipi, *supra* note 37, at 5; Brian Switek, *How to Resurrect Lost Species*, NAT'L GEOGRAPHIC NEWS (Mar. 11, 2013), <http://news.nationalgeographic.com/news/2013/13/130310-extinct-species-cloning-deextinction-genetics-science/>.

59. Ogden, *supra* note 57, at 470.

60. *Id.* at 471.

61. Switek, *supra* note 58.

62. Oksanen & Siipi, *supra* note 37, at 8; see Beth Shapiro, *Mammoth 2.0: Will Genome Engineering Resurrect Extinct Species?*, 16 GENOME BIOLOGY, Nov. 4, 2015, at 1, <http://genomebiology.biomedcentral.com/articles/10.1186/s13059-015-0800-4> (discussing some recent successes of de-extinction teams and providing an overview of the technologies being used to work on de-extinction).

63. SHAPIRO, *supra* note 7, at 10; Revive & Restore, *supra* note 51.

64. Jones, *supra* note 41, at 20. Cloning probably will not be used for the de-extinction of many species. SHAPIRO, *supra* note 7, at 45.

65. Jones, *supra* note 41, at 20–21.

66. *Id.*

67. *Id.* at 21.

II. EXISTING INTERNATIONAL TREATIES AND DE-EXTINCTION: AN INCOMPLETE AND INCONSISTENT FRAMEWORK

A few legal scholars have begun to analyze the legal and policy issues associated with de-extinction but thus far have done so primarily in the context of domestic (United States) laws.⁶⁸ While the effect and significance of the United States' (and other countries') domestic legislation cannot be overstated,⁶⁹ many of the species that are considered viable candidates for some form of de-extinction are not species whose habitats or migration routes are exclusive to, or even include, the United States. For example, the distribution of the great auk included the coasts of Newfoundland, Canada, the United States, Greenland, Iceland, and several other countries.⁷⁰ The range of the passenger pigeon included the United States and Canada,⁷¹ and the giant moa was endemic to New Zealand.⁷² The bucardo was found in the Iberian Peninsula, and the gastric brooding frog was native to Australia.⁷³ Regardless of where de-extinct species' original ranges were previously and might be in the future, these species will be introduced (intentionally or unintentionally) to new locations and inevitably will cross national boundaries. Accordingly, de-extinction will have significant foreign and international legal and policy implications.⁷⁴

This Part explains some of the main international treaties that likely will provide for the regulation and protection of de-extinct species, and it assesses whether those treaties can adequately address the issues related to de-extinct species. De-extinct species may be regulated and protected through trade restrictions, as migratory species, as biodiversity generally, or as genetically modified organisms, and this Part analyzes the international treaties under which de-extinct species may be affected as such. Additionally, it examines

68. See the legal articles cited *supra* note 38, discussing domestic laws.

69. This Article is not meant to, and does not, address the myriad of ways in which countries might recognize and regulate de-extinct species within their national legal and policy frameworks. How countries respond at a national level certainly will be an important issue and will largely affect how de-extinct species are regulated and protected.

70. BirdLife Int'l, *Great Auk* *Pinguinus impennis*, <http://www.birdlife.org/datazone/species/factsheet/22694856> (last visited Feb. 6, 2016); see also Revive & Restore, *Candidate Species for De-Extinction*, *supra* note 57.

71. BirdLife Int'l, *Passenger Pigeon* *Ectopistes migratorius*, <http://www.birdlife.org/datazone/species/factsheet/22690733> (last visited Feb. 6, 2016); see also Revive & Restore, *Candidate Species for De-Extinction*, *supra* note 57.

72. Virginia Morell, *Why Did New Zealand's Moas Go Extinct?*, *SCIENCE* (March 17, 2014, 3:15 PM), <http://www.sciencemag.org/news/2014/03/why-did-new-zealands-moas-go-extinct>; see also Revive & Restore, *Candidate Species for De-Extinction*, *supra* note 57.

73. Paul Rincon, *Fresh Effort to Clone Extinct Animal*, *BBC NEWS* (Nov. 22, 2013), <http://www.bbc.com/news/science-environment-25052233>; Rheobatrachus silus—*Southern Gastric-brooding Frog*, AUSTRALIAN GOV'T, DEP'T OF THE ENV'T, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1909 (last visited Feb. 6, 2016); Ed Yong, *Resurrecting the Extinct Frog with a Stomach for a Womb*, *NAT'L GEOGRAPHIC* (Mar. 15, 2013), <http://phenomena.nationalgeographic.com/2013/03/15/resurrecting-the-extinct-frog-with-a-stomach-for-a-womb/>.

74. See SHAPIRO, *supra* note 7, at 187 (explaining how de-extinction does not fit into current regulatory frameworks).

how de-extinct species might fit into intellectual property regimes by discussing some of the applicable international intellectual property treaties.

A. Regulating and Protecting De-extinct Species through Trade and as Endangered Species

Under existing international treaties, de-extinct species could be addressed in a variety of ways. Inevitably, people will be attracted to the novelty of de-extinct species and will want to purchase them commercially. As such, it will be necessary to regulate the potential international trade in de-extinct species, which could be achieved in part through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Certain de-extinct species may migrate across national borders, and those species might find some measure of protection through the Convention on the Conservation of Migratory Species of Wild Animals (CMS).⁷⁵ De-extinct species also will need to be protected and regulated as part of the world's biodiversity, and the Convention on Biological Diversity (CBD) thus will play an important role in de-extinction. This subpart analyzes each of these multilateral environmental agreements and their potential effects on de-extinct species.

1. CITES: De-extinct Specimens as Objects of Trade

CITES⁷⁶ is a multilateral environmental agreement that seeks “to ensure that international trade in specimens of wild animals and plants does not threaten their survival.”⁷⁷ Opened for signature in 1973, this international treaty entered into force in 1975 and has been joined by 183 countries.⁷⁸ In terms of the number of parties to the convention, CITES is one of the most widely supported international conservation agreements⁷⁹ and arguably one of the most successful.⁸⁰

75. In addition to protecting and regulating the de-extinct species themselves, the international community will need to consider how to manage the de-extinct species' habitats.

76. Convention on International Trade in Endangered Species of Wild Fauna and Flora, Mar. 3, 1973, 27 U.S.T. 1087, 993 U.N.T.S. 243 [hereinafter CITES].

77. *What Is CITES?*, CITES, <https://www.cites.org/eng/disc/what.php> (last visited Feb. 6, 2016).

78. *Id.*; *Member Countries*, CITES, <https://www.cites.org/eng/disc/parties/index.php> (last visited Sept. 3, 2016); *see also The 183rd Party to CITES: Tonga*, CITES (Aug. 26, 2016), https://www.cites.org/eng/news/183rd_Party_Tonga_26082016 (announcing that Tonga joined as the 183rd CITES Party). The United Nations Environment Programme administers the CITES Secretariat, which is located in Geneva, Switzerland. CITES, *supra* note 76, art. XII (describing the functions of the CITES Secretariat); *see also The CITES Secretariat*, CITES, <https://www.cites.org/eng/disc/sec/index.php> (last visited Apr. 25, 2016). CITES does not have a separate enforcement mechanism, and instead, the Parties are supposed to “take appropriate measures to enforce” the treaty. CITES, *supra* note 76, art. VIII(1).

79. *What is CITES?*, *supra* note 77.

80. Shennie Patel, *What Is CITES and How Does It Work for Prosecutors?*, 60 U.S. ATT'YS' BULL. 4, 6–7 (2012), <http://www.justice.gov/sites/default/files/usao/legacy/2012/07/30/usab6004.pdf>. *But see* Paul Matthews, *Problems Related to the Convention on the International Trade in Endangered Species*, 45 INT'L & COMP. L.Q. 421, 421–22 (1996) (discussing some of the shortcomings of the convention).

a. *How CITES Works*

CITES covers a staggering number of organisms—approximately 5600 animal species and 30,000 plant species.⁸¹ One purpose of the convention is to prevent the extinction of species,⁸² and to do so, CITES regulates the international trade of listed species.⁸³ The species that CITES covers are listed in the convention's three Appendices (I, II, or III).⁸⁴ Parties to the convention are prohibited from trading CITES-listed species except as provided for by the convention.⁸⁵ The three Appendices afford listed species varying levels of protection; Appendix I provides the most stringent trade restrictions for listed species.⁸⁶

Appendix I species are those “threatened with extinction which are or may be affected by trade,”⁸⁷ such as the red panda, the tiger, the Asian elephant, and the sloth bear.⁸⁸ To trade an Appendix I species internationally,⁸⁹ appropriate permits are required, and commercial trade is prohibited.⁹⁰ Parties must designate at least one Management Authority to administer the permit system and at least one Scientific Authority to provide advice about how a species may be affected by trade.⁹¹ Exporting an Appendix I species requires an export permit,⁹² and to import an Appendix I species, one must obtain an import permit, as well as “either an export permit or a re-export certificate.”⁹³

81. *The CITES Species*, CITES, <https://www.cites.org/eng/disc/species.php> (last visited Feb. 6, 2016).

82. Patel, *supra* note 80, at 6, 7.

83. *How CITES Works*, CITES, <https://www.cites.org/eng/disc/how.php> (last visited Feb. 6, 2016).

84. *Id.*

85. CITES, *supra* note 76, art. II(4).

86. *Id.* art II(1); *How CITES Works*, *supra* note 83; *The CITES Species*, *supra* note 81.

87. CITES, *supra* note 76, art. II(1).

88. *Appendices I, II, and III*, CITES, <https://www.cites.org/eng/app/appendices.php> (last updated Mar. 10, 2016).

89. Unless noted otherwise, all references to “trade” in this Article refer to international trade, as CITES does not apply to strictly domestic trade.

90. CITES, *supra* note 76, art. III(2)–(3).

91. *How CITES Works*, *supra* note 83.

92. CITES, *supra* note 76, art. III(2). To obtain an export permit, the exporting country's Scientific Authority must advise that the “export will not be detrimental to the survival of that species.” *Id.* Additionally, the exporting country's Management Authority must determine that the specimen to be traded was not acquired in violation of the country's domestic plant and animal protection laws, that a living specimen will be shipped in a manner that will minimize the chance of injury, and that the importing country has granted the necessary import permit. *Id.*

93. *Id.* art. III(3). The importing country's Scientific Authority must “advise[] that the import will be for purposes which are not detrimental to the survival of the species” and determine that the proposed recipient will be able to adequately take care of a living specimen. *Id.* An import permit also requires the importing country's Management Authority to determine that the imported “specimen is not to be used for primarily commercial purposes.” *Id.* To obtain a re-export certificate, the re-exporting country's Management Authority must conclude that the specimen was imported in compliance with the requirements of CITES, that a living specimen will be shipped in a manner that will minimize the likelihood of injury, and that the appropriate import permit has been obtained for a living specimen. *Id.* art. III(4).

Appendix II species are those that are not currently threatened with extinction but may become so if trade of those species is not strictly regulated.⁹⁴ Appendix II also includes those species that must be regulated to ensure that trade of Appendix I species can be effectively controlled.⁹⁵ Species in the latter category may be listed in Appendix II if (1) the specimens of that species resemble specimens of either an Appendix I species or an Appendix II species listed under the former category (“look-alike” species),⁹⁶ or (2) other compelling reasons exist to ensure that trade of CITES-listed species can be effectively controlled.⁹⁷ Appendix II species include the great white shark, the queen conch, and the pygmy hippopotamus.⁹⁸ The northern and southern gastric brooding frogs—species that are the subject of current de-extinction research⁹⁹—were listed in Appendix II but were removed after they went extinct.¹⁰⁰

The restrictions on trade of Appendix II species are not as exacting as the restrictions on trade of Appendix I species because import permits are not required for Appendix II species, and these species may be traded commercially under certain circumstances.¹⁰¹ In contrast to the requirements for obtaining an import permit for an Appendix I species, the importation of a species listed in Appendix II requires only “an export permit or a re-export certificate.”¹⁰² Essentially, the restrictions on trade of Appendix I species regulate both import and export of those species, whereas the restrictions on trade of Appendix II species focus primarily on the export of those species and are considerably less rigorous.

Trade in species listed in Appendix III is even less restrictive. Appendix III species are those that a CITES Party has identified as being regulated within

94. *Id.* art. II(2).

95. *Id.*

96. It is conceivable that a de-extinct species could qualify for Appendix II protection by being considered a look-alike species, and this notion is explored more fully below.

97. CITES, Resolution Conf. 9.24 (Rev. CoP16), Criteria for Amendment of Appendices I and II, at annex 2 b (1994) [hereinafter CITES Res. 9.24].

98. *Appendices I, II, and III, supra* note 88.

99. See Revive & Restore, *Candidate Species for De-Extinction, supra* note 57.

100. CITES, *Notification to the Parties: Amendments to Appendices I and II of the Convention*, No. 2013/012 (Apr. 19, 2013), at 2, <https://cites.org/sites/default/files/eng/notif/2013/E-Notif-2013-012.pdf>; CITES, *Review of the Status of Southern Gastric-brooding Frog (Rheobatrachus silus)*, AC26 Inf. 18 (Mar. 2012), at 8, <https://cites.org/sites/default/files/common/com/ac/26/E26-18i.pdf>; CITES, *Review of the Status of Northern Gastric-brooding Frog (Rheobatrachus vitellinus)*, AC26 Inf. 19 (Mar. 2012), at 10, <https://cites.org/sites/default/files/common/com/ac/26/E26-19i.pdf>.

101. See CITES, *supra* note 76, art. IV(4). Somewhat similar to the process for Appendix I species, to obtain the required export permit for a species listed in Appendix II, the exporting country’s Scientific Authority must “advise[] that such export will not be detrimental to the survival of that species,” and that country’s Management Authority must determine that the specimen to be traded was not acquired in violation of the country’s domestic plant and animal protection laws, and that a living specimen will be shipped in a manner that will minimize the chance of injury. *Id.* art. IV(2). To obtain a re-export certificate for an Appendix II species, all that is required is that the re-exporting country’s Management Authority determine that the import complied with CITES requirements and that a living specimen will be shipped in a manner that will minimize the likelihood of injury. *Id.* art. IV(5).

102. *Id.* art. IV(4).

that country to prevent or restrict exploitation, and the Party needs the other CITES Parties' cooperation to control the trade of that species.¹⁰³ An export permit must be obtained to export a species from any country that has listed that species in Appendix III.¹⁰⁴ All that is required to import an Appendix III species is "the prior presentation of a certificate of origin and, where the import is from a [Party] which has included that species in Appendix III, an export permit."¹⁰⁵

CITES includes several special provisions and exemptions from its trade restrictions.¹⁰⁶ For instance, subject to certain exceptions, the convention's trade restrictions do "not apply to specimens that are personal or household effects."¹⁰⁷ Another exemption allows a country's Management Authority to waive the permit requirements for certain "specimens which form part of a travelling zoo, circus, menagerie, plant exhibition or other travelling exhibition."¹⁰⁸ The convention's permit requirements also are inapplicable to herbarium specimens, certain museum specimens, and live plant material that is exchanged between scientists.¹⁰⁹

Two special CITES provisions address species that are bred in captivity¹¹⁰ and may have significant implications for de-extinct species. One provision provides that a specimen of an Appendix I animal species that was "bred in captivity for commercial purposes" shall be treated as if it were a specimen of an Appendix II species and thus receive lesser protections.¹¹¹ The second provision allows for a certificate from an exporting country's Management Authority to be used in lieu of the other permits or certificates required by CITES as long as that Management Authority has determined that "that any specimen of an animal species was bred in captivity . . . or is a part of such an animal or plant or was derived therefrom."¹¹² The Article examines the possible consequences of these two provisions for de-extinct species in more detail below.¹¹³

103. *Id.* art. II(3). For example, Uruguay has listed the broad-nosed bat in Appendix III. *Appendices I, II, and III, supra* note 88.

104. CITES, *supra* note 76, art. V(2). An export permit from such a country requires that country's Management Authority to determine that the Appendix III species was not acquired in violation of the country's domestic plant and animal protection laws, and that a living specimen will be shipped in a manner that will minimize the chance of injury. *Id.* Note that an export permit would not be required to export an Appendix III species from a country that has not listed that species on Appendix III. *See id.*

105. *Id.* art. V(3). Re-exporting an Appendix III species is not particularly onerous; the importing country may accept a certificate from the re-exporting country's Management Authority to the effect "that the specimen was processed in that State or is being re-exported." *Id.* art. V(4).

106. *See id.* art. VII.

107. *Id.* art. VII(3). In addition, the treaty's restrictions do "not apply to the transit or transshipment of specimens through or in the territory of a Party while the specimens remain in Customs control." *Id.* art. VII(1).

108. *Id.* art. VII(7).

109. *Id.* art. VII(6).

110. *Id.* art. VII(4)–(5).

111. *Id.* art. VII(4).

112. *Id.* art. VII(5).

113. *See infra* Part II.A.1.c.

CITES defines “species” to mean “any species, subspecies, or geographically separate population thereof.”¹¹⁴ The convention applies to a whole group of animals or plants (such as cetaceans and coral), but it also may apply to only a specific subspecies or even to a particular population of a species.¹¹⁵ CITES Parties can propose that Appendix I or II be amended to add a species, remove a species, or move a species to a different Appendix.¹¹⁶ Certain criteria, discussed below, must be met for those amendments to be approved. At any time, a Party may submit and amend lists of species that it identifies for purposes of Appendix III.¹¹⁷

b. CITES and De-extinction

Not surprisingly, the text, resolutions, decisions, and other documents of CITES do not address de-extinction, but the concept of extinction is the driving force behind the convention. If a species goes extinct, a Party may propose that the species be removed from the CITES Appendix in which it was listed.¹¹⁸ CITES Resolution 9.24 provides, however, that “[s]pecies that are regarded as possibly extinct should not be deleted from Appendix I if they may be affected by trade in the event of their rediscovery.”¹¹⁹

Although CITES contemplates, and is driven by, extinction, the convention does not directly address de-extinction, so it is necessary to consider whether CITES could apply to de-extinct species. Four of the five introductory statements in the treaty’s preamble include a reference to *wild* fauna and flora.¹²⁰ While the preamble is not binding and does not necessarily limit the convention’s applicability solely to wild fauna and flora, the use of the

114. CITES, *supra* note 76, art. I(a). According to Resolution 9.24, the terms “[s]pecies’ and ‘subspecies’ refer to the biological concept of a species, and do not require any further definition.” CITES Res. 9.24, *supra* note 97, annex 5.

115. *The CITES Species*, *supra* note 81. For example, the populations of African elephants that are located in Botswana, Namibia, South Africa, and Zimbabwe are in Appendix II, but all other African elephant populations are in Appendix I. *Appendices I, II, and III*, *supra* note 88.

116. CITES, *supra* note 76, art. XV. Regular meetings of the Conference of the Parties occur at least every two years. *Id.* art. XI(2). There is also a rarely used postal procedure to propose amendments between regular meetings. *Id.* art. XV(2); *How CITES Works*, *supra* note 83.

117. CITES, *supra* note 76, art. XVI. Appendix III listings do not require a vote and are essentially automatic. *See id.* Other Parties may enter a reservation to a proposed Appendix III listing, and if a Party enters a reservation to an Appendix III listing, any restrictions resulting from that listing do not apply to that Party. *See id.* art. XVI(2).

118. *See, e.g.*, CITES, CoP16 Prop. 22, Consideration of Proposals for Amendment of Appendices I and II, at 1 (2013), <https://www.cites.org/eng/cop/16/prop/E-CoP16-Prop-22.pdf> (proposing removal of the laughing owl because it is extinct).

119. CITES Res. 9.24, *supra* note 97, annex 4. These species should be annotated in the Appendices as “possibly extinct.” *Id.* Four species are currently listed as “possibly extinct” in the CITES Appendices. *Appendices I, II, and III*, *supra* note 88. Resolution 9.24 also defines “possibly extinct,” explaining that “[a] species is ‘possibly extinct’ when exhaustive surveys in known or suspected habitat, and at appropriate times . . . , throughout its historical range have failed to record an individual.” CITES Res. 9.24, *supra* note 97, annex 5. “Before a species can be declared possibly extinct, surveys should take place over a time-frame appropriate to the species’ life cycle and life form.” *Id.*

120. CITES, *supra* note 76, pmbl.

term “wild” four times does suggest that the focus is on the international trade of wild plants and animals. One could argue that a de-extinct species that has been introduced and established in the wild should be considered a wild species, but it is unclear how soon after introduction it would be “wild.”¹²¹

Irrespective of whether a de-extinct species is “wild,” another threshold consideration is how the convention defines a species. As noted above, a species is defined to include “any species, subspecies, or geographically separate population thereof.”¹²² A de-extinct species almost certainly would qualify as a “species” for purposes of CITES under any of the three categories: species, subspecies, or geographically separate population. If a de-extinct species were considered to be almost the exact same species that it was before it went extinct, or if the de-extinct species were considered to be an entirely new species, it could qualify as a species under the CITES definition. If selective back-breeding or strategic mating is used (or depending on how genetically distinct a de-extinct species is that has been resurrected by other methods), the de-extinct species conceivably could be classified as a subspecies or separate population of a living species. Even if that were the case (and regardless of the method used to resurrect the species), the de-extinct species could qualify as a species under CITES because of the convention’s broad definition of the term.

Having determined that the definition of “species” would not preclude listing of a de-extinct species, whether a Party could propose that a de-extinct species be included in any of the CITES Appendices is a critical consideration because a species must be *listed* in one of the Appendices to be covered by the convention. Appendix I species are those “threatened with extinction which are or may be affected by trade.”¹²³ Under Resolution 9.24, for a species “to be threatened with extinction,” the species must meet at least one of three main criteria related to population size, population distribution, and population trend.¹²⁴ The criterion regarding population size requires that

[t]he wild population is small, and is characterized by at least one of the following: i) an observed, inferred or projected decline in the number of individuals or the area and quality of habitat; ii) each subpopulation being very small; iii) a majority of individuals being concentrated geographically during one or more life-history phases; iv) large short-term fluctuations in population size; or v) a high vulnerability to either intrinsic or extrinsic factors.¹²⁵

121. It probably will take several generations in captivity before there will be enough specimens to reintroduce into the wild. SHAPIRO, *supra* note 7, at 169. It is uncertain whether the first specimens released would be considered wild or whether a particular specimen would need to have been born in the wild to be considered wild. It also could be argued that a species that is created or recreated is not truly “wild.”

122. CITES, *supra* note 76, art. I.

123. *Id.* art. II(1).

124. CITES Res. 9.24, *supra* note 97, annex 1.

125. *Id.*

A de-extinct species probably could qualify as “threatened with extinction” under this criterion. Initially, wild populations of de-extinct species likely would be quite small and would continue to be so for many decades (if not centuries). While it is far from clear that a de-extinct species would meet the first of the initial sub-criteria related to a decline in numbers or habitat (because that information may be difficult to determine or project, at least initially), a de-extinct species could satisfy one or more of the other sub-criteria. Subpopulations (if any) likely would be small, and at least for some species, the individuals probably would be concentrated within a relatively small geographic area during the de-extinct species’ early years of introduction to the wild. The de-extinct species undoubtedly would be vulnerable to a variety of factors (such as predators and disease), especially given that the number of individuals initially would be small and because it would be unclear how the de-extinct species would respond to its new environment. Because a de-extinct species could meet the population size criterion, a Party could propose that such a species be listed in Appendix I (assuming, of course, that the de-extinct species is or may be affected by trade).¹²⁶

Additionally, the criterion addressing population distribution probably would apply. This criterion requires that

[t]he wild population has a restricted area of distribution and is characterized by at least one of the following: i) fragmentation or occurrence at very few locations; ii) large fluctuations in the area of distribution or the number of subpopulations; iii) a high vulnerability to either intrinsic or extrinsic factors; or iv) an observed, inferred or projected decrease in any one of the following: the area of distribution; the area of habitat; the number of subpopulations; the number of individuals; the quality of habitat; or the recruitment.¹²⁷

As noted above, the distribution of some populations of de-extinct species likely would be restricted, which satisfies the first portion of this criterion. Under sub-criterion (i), it seems probable that a de-extinct species initially would live in just one or very few locations, and under sub-criterion (iii), the de-extinct species would be vulnerable, particularly at first.¹²⁸ Because it could meet at least one of these sub-criteria, a Party could propose that a de-extinct species be listed pursuant to the population distribution criterion.¹²⁹

Data and time limitations might reduce a de-extinct species’ ability to qualify for Appendix I listing under the biological criterion that relates to population trend, which requires

126. This may be a big assumption. Whether any de-extinct species would be threatened by trade (especially at first) is uncertain, but it is conceivable, particularly if a de-extinct species were to become well established in the wild.

127. CITES Res. 9.24, *supra* note 97, annex 1.

128. It may be more difficult for a de-extinct species to meet the second and fourth sub-criteria due to data and time limitations.

129. This again assumes that trade affects or may affect the de-extinct species.

[a] marked decline in the population size in the wild, which has been either: i) observed as ongoing or as having occurred in the past (but with a potential to resume); or ii) inferred or projected on the basis of any one of the following: a decrease in area of habitat; a decrease in quality of habitat; levels or patterns of exploitation; a high vulnerability to either intrinsic or extrinsic factors; or a decreasing recruitment.¹³⁰

When a de-extinct species population is first introduced, it would not be possible to observe an ongoing or past marked decline because the species would have been previously extinct; this likely would preclude it from satisfying the first sub-criterion. It also would be difficult (if not impossible) to project whether the population would experience a marked decline due to any of the potential causes listed in the second sub-criterion. Therefore, it seems less probable that a de-extinct species would meet the criterion related to population trend. But as described above, a de-extinct species probably could meet at least one of the other two criteria (population size or population distribution), either of which would allow for Appendix I listing.

It is also possible that a de-extinct species could be listed under Appendix II, which covers species that are not currently threatened with extinction but may become threatened if trade in the species is not strictly regulated.¹³¹ Appendix II species also include those species (such as look-alike species) that need to be regulated so that the trade of other listed species may be controlled effectively.¹³² Under the first option for Appendix II designation, a species may be listed if it meets at least one of the following two biological criteria:

(A) It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future; or (B) [i]t is known, or can be inferred or projected, that regulation of trade in the species is required to ensure that the harvest of specimens from the wild is not reducing the wild population to a level at which its survival might be threatened by continued harvesting or other influences.¹³³

It is difficult to predict whether a de-extinct species would qualify for Appendix II listing based on these two criteria, but it could. For example, a country might infer that a de-extinct species is at risk of eligibility for Appendix I listing and that it is necessary to regulate trade in the de-extinct species. Accordingly, the de-extinct species might be eligible for listing in Appendix II under criterion (A). Alternatively (or additionally), if it became clear that specimens of the de-extinct species were being harvested for trade at an unsustainable level, a country could propose that the de-extinct species be listed under Appendix II because it would meet criterion (B).

130. CITES Res. 9.24, *supra* note 97, annex 1.

131. CITES, *supra* note 76, art. II(2)(a).

132. *Id.* art. II(2)(b).

133. CITES Res. 9.24, *supra* note 97, annex 2 a.

Furthermore, de-extinct species might be eligible for Appendix II designation under the second option, pursuant to which a species may be listed if:

(A) The specimens of the species in the form in which they are traded resemble specimens of a species included in Appendix II under the provisions of Article II, paragraph 2 (a), or in Appendix I, so that enforcement officers who encounter specimens of CITES-listed species are unlikely to be able to distinguish between them; or (B) [t]here are compelling reasons other than those given in criterion A above to ensure that effective control of trade in currently listed species is achieved.¹³⁴

Criterion (A) addresses look-alike species and could apply to some de-extinct species; however, for some extinct species, such as the dodo, this criterion might not apply because the de-extinct species would not really resemble any living species listed in Appendix I or II. For other de-extinct species that resemble a living species, if that living species is not listed in a CITES Appendix, then the de-extinct species would not qualify for CITES listing under the look-alike criterion. This could be the case for the passenger pigeon, a potential look-alike species to the band-tailed pigeon, which is not listed in a CITES Appendix.¹³⁵

At least some of the candidate species for de-extinction, however, may resemble living species that are listed in Appendix I or II. For example, the first few generations of de-extinct woolly mammoths probably would look like Asian elephants (perhaps with more hair),¹³⁶ so the woolly mammoth might meet criterion (A) above as a look-alike species to the Asian elephant, which is listed in Appendix I.¹³⁷ Similarly, the heath hen, another candidate for de-extinction, might qualify as a look-alike species because it resembles the living Attwater's prairie chicken, which is listed in CITES Appendix II.¹³⁸

In addition to possibly qualifying for listing in Appendix I or II, de-extinct species could be listed in Appendix III, which includes species that "any Party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the co-operation of other Parties in the control of trade."¹³⁹ If a de-extinct species could not be listed (for example, because it does not meet the necessary biological criteria) or is not listed (perhaps simply because no CITES Party has petitioned to list the species or because a proposal is not approved) in Appendix I or Appendix II, the de-extinct species could be listed in Appendix III and receive at least some measure of protection. A country might find it necessary to restrict the exploitation of a de-extinct species and could enact domestic legislation to

134. *Id.* annex 2 b.

135. Revive & Restore, *Criteria Checklist: Passenger Pigeon*, *supra* note 57.

136. See Revive & Restore, *Woolly Mammoth Revival*, *supra* note 57.

137. *Appendices I, II, and III*, *supra* note 88. After several generations, however, they might not qualify as look-alikes anymore because their features would become more distinct from elephants.

138. *Id.*; Revive & Restore, *Heath Hen Revival Project*, *supra* note 57.

139. CITES, *supra* note 76, art. II(3).

protect that de-extinct species. The country could list that de-extinct species in Appendix III if it needed the other CITES Parties' assistance to control international trade of specimens of that de-extinct species. This would ensure that an export permit would be required for any export of a specimen of that de-extinct species from the listing country.

While this would not provide the same trade restrictions as an Appendix I or II listing, an Appendix III listing would help control trade of specimens of the de-extinct species. Initially, any de-extinct species likely would be geographically restricted to one or two countries. If most or all of the specimens of the de-extinct species are living in one country and are subject to protection under that country's domestic laws or regulations, then an Appendix III listing by that country would help to guarantee that international trade in virtually any specimen of that de-extinct species would, at the very least, require an export permit from that country. This would further enhance any domestic legislation related to that de-extinct species because a specimen could not be traded if it were obtained in violation of the country's domestic legislation.¹⁴⁰

Depending on the type of de-extinct species and the particular circumstances, it is possible that a de-extinct species could qualify for listing in any of the three CITES Appendices. Despite the possibility of a de-extinct species receiving some protection through an Appendix III listing (especially if the listing country had robust national legislation in place), an Appendix I or II listing would provide more stringent trade restrictions. A listing in Appendix II could help to protect the de-extinct species through export permit requirements, and an Appendix I listing would provide a stronger measure of protection to the de-extinct species by essentially prohibiting all commercial trade of the species.

c. CITES Exemptions and Special Provisions

As noted above, CITES contains two special provisions that lessen the trade restrictions for specimens bred in captivity.¹⁴¹ These provisions could have meaningful consequences for de-extinct species, as many of the specimens of a de-extinct species will be bred in captivity initially. Under Article VII(4), if a de-extinct species were listed in Appendix I, then a specimen of the de-extinct species that was "bred in captivity for commercial purposes" would receive only the lesser trade restrictions applicable to an Appendix II species. Even if Article VII(4) did not apply to a de-extinct species, most of the permit requirements of CITES could be avoided, pursuant to Article VII(5), by obtaining a captive breeding certificate for a specimen of

140. This might provide significant protection for de-extinct species that could be reintroduced and geographically confined to one country (such as the giant moa, which was endemic to New Zealand).

141. CITES, *supra* note 76, art. VII(4)–(5).

the de-extinct species. These two provisions thus could lead to fewer CITES protections for certain de-extinct species.

In 1997, the CITES Parties expressed concern that “much trade in specimens declared as bred in captivity remains contrary to the Convention and to Resolutions of the Conference of the Parties, and may be detrimental to the survival of wild populations of the species,” and sought to clarify the definition of “bred in captivity.”¹⁴² The definition is quite detailed and extensive,¹⁴³ but to summarize, specimens bred in captivity are those that are “born or otherwise produced in a controlled environment”¹⁴⁴ and whose parents mated (or whose gametes were transferred) in a controlled environment or whose parents were located in a controlled environment when the offspring started to develop.¹⁴⁵ The definition also requires that the breeding stock¹⁴⁶ be established in accordance with applicable national laws and CITES and in such a way that is

142. CITES, Resolution Conf. 10.16 (Rev.), Specimens of Animal Species Bred in Captivity (1997) [hereinafter CITES Res. 10.16].

143. The full definition is as follows:

The term ‘bred in captivity’ shall be interpreted to refer only to specimens, as defined in Article I, paragraph (b), of the Convention, born or otherwise produced in a controlled environment, and shall apply only if:

i) the parents mated or gametes were otherwise transferred in a controlled environment, if reproduction is sexual, or the parents were in a controlled environment when development of the offspring began, if reproduction is asexual; and

ii) the breeding stock, to the satisfaction of the competent government authorities of the exporting country:

A. was established in accordance with the provisions of CITES and relevant national laws and in a manner not detrimental to the survival of the species in the wild;

B. is maintained without the introduction of specimens from the wild, except for the occasional addition of animals, eggs or gametes, in accordance with the provisions of CITES and relevant national laws and in a manner not detrimental to the survival of the species in the wild as advised by the Scientific Authority:

1. to prevent or alleviate deleterious inbreeding, with the magnitude of such addition determined by the need for new genetic material; or

2. to dispose of confiscated animals in accordance with Resolution Conf. 10.7 (Rev. CoP15); or

3. exceptionally, for use as breeding stock; and

C.

1. has produced offspring of second generation (F2) or subsequent generation (F3, F4, etc.) in a controlled environment; or

2. is managed in a manner that has been demonstrated to be capable of reliably producing second-generation offspring in a controlled environment[.]

Id.

144. *Id.* A controlled environment is essentially an environment whose purpose is to produce animals of a specific species and that has boundaries to block the entrance or exit of the species’ animals, eggs, or gametes, and that has other characteristics such as artificial housing and waste removal. *Id.*

145. *Id.*

146. “[T]he ‘breeding stock’ of an operation means the ensemble of the animals in the operation that are used for reproduction.” *Id.*

“not detrimental to the survival of the species in the wild,” that the breeding stock be maintained with only the occasional introduction of specimens from the wild, and that the breeding stock be produced, or be able to produce, “second-generation offspring in a controlled environment.”¹⁴⁷

Regardless of the de-extinction method used, any de-extinction project likely would meet the second set of requirements (related to the breeding stock) within the definition. Hopefully (although not necessarily), a de-extinction project’s breeding stock will be established in compliance with any applicable national laws and CITES, and if the scientists are trying to bring one species back from extinction, it would seem to be counterproductive for them to do anything to the breeding stock specimens that would be “detrimental to the survival of the [living breeding stock] species in the wild.”¹⁴⁸ Further, such a program presumably would include the introduction of only a few specimens of the living species from the wild with the implicit goal that the breeding stock would be able to produce “second-generation offspring in a controlled environment.”¹⁴⁹

Looking back at the first portion of the definition, many of the early specimens of a de-extinct species will be created or born in controlled environments; however, it is less clear that their parents will mate (or the gametes will be transferred) in a controlled environment or that their parents will be within that controlled environment when the de-extinct specimens start to develop. The type of method used to create the de-extinct specimen may influence this determination. In the cases of cloning and genetic engineering, at most only one of the two parents could possibly be in a controlled environment (because one “parent” is extinct), so the parents could not mate in a controlled environment or be within a controlled environment when the de-extinct specimen starts to develop. It might be possible, however, to contend that the definition should still apply because the gametes would be transferred (such as when the nucleus from the cloned extinct animal is transferred into the egg cell of the host parent animal of the living species) in a controlled environment. In the case of selective mating, the de-extinct specimens are even more likely to be considered “bred in captivity” because both parents could mate in a controlled environment.¹⁵⁰

147. *Id.*

148. *Id.*

149. *Id.*

150. Another issue is found in section (h) of Resolution 9.24, which states, “species of which all specimens in trade have been bred in captivity or artificially propagated should not be included in the Appendices if there is a negligible probability of trade taking place in specimens of wild origin.” CITES Res. 9.24, *supra* note 97, ¶ (h). If, through some unintentional or poorly conceived legal loophole in a country’s national legislation, it were possible to somehow acquire and trade specimens of a de-extinct species in that country, this provision might hamper a de-extinct species’ chances of being listed in a CITES Appendix. As discussed above, the populations of de-extinct species likely would be small initially, and at first, many of the specimens in the wild population could be specimens that would meet the definition of a specimen “bred in captivity.” Assuming that some of these de-extinct specimens were acquired legally and traded within the first few years of the de-extinct species being introduced to the

It is also important to consider how de-extinct species might be treated as hybrids under CITES. Resolution 9.24 states that “hybrids may be specifically included in the Appendices but only if they form distinct and stable populations in the wild.”¹⁵¹ A de-extinct species will never be exactly the same as before it went extinct but instead will be a close approximation or a hybrid. If a de-extinct species were considered a hybrid for CITES purposes, it could be listed in a CITES Appendix if the wild population were distinct and stable (as required by Resolution 9.24) and if it met the required listing criteria.¹⁵² Assuredly, one of the goals of reintroducing a de-extinct species would be for the wild populations of that de-extinct species to be stable. Furthermore, the population of a de-extinct species in the wild could be a distinct population almost by default because it would be genetically distinct (at least to a certain extent) from any living species or population of a living species. Accordingly, Resolution 9.24’s requirements for hybrids probably would not preclude the listing of a de-extinct species.

Resolution 10.17 clarifies how CITES addresses animal hybrids; hybrids are treated like CITES-listed species if the recent lineage of the hybrids includes one or more specimens of an Appendix I or Appendix II species.¹⁵³ Hybrids are treated as Appendix I species “if at least one of the animals in the recent lineage is of a species included in Appendix I,” and hybrids are treated as Appendix II species “if at least one of the animals in the recent lineage is of a species included in Appendix II, and there are no specimens of an Appendix-I species in such lineage.”¹⁵⁴ Under Resolution 10.17, some de-extinct species could receive the benefits of the trade restrictions for hybrids. For example, the woolly mammoth might qualify as a hybrid and be treated as an Appendix I species because its recent lineage likely would include the Asian elephant, an Appendix I species.¹⁵⁵ But the trade controls for hybrids would not help a de-extinct species (such as the passenger pigeon) whose recent lineage did not include an Appendix I or Appendix II species. The hybrid trade controls could,

wild, it is possible that all of the specimens in trade would have been specimens that were bred in captivity, and the argument could be made that the probability of trading in specimens from the wild is negligible and that the de-extinct species thus should not be listed in a CITES Appendix. Presumably, however, eventually there would be (even as quickly as one generation later) specimens born in the wild that would no longer meet the definition of bred in captivity, and in that case, this section of Resolution 9.24 no longer would be much of an issue for de-extinct species.

151. *Id.* ¶ (g).

152. *See supra* Part II.A.1.b (discussing the listing criteria for the Appendices).

153. CITES, Resolution Conf. 10.17 (Rev. CoP14), Animal Hybrids (1997) [hereinafter CITES Res. 10.17].

154. *Id.* The phrase “recent lineage” is interpreted generally “to refer to the previous four generations of the lineage.” *Id.*

155. Revive & Restore, *Woolly Mammoth Revival*, *supra* note 57; *Appendices I, II, and III*, *supra* note 88. Unfortunately, the hybrid trade restrictions in Resolution 10.17 might not benefit certain de-extinct species, such as the woolly mammoth, after five or more generations because the recent lineage typically includes only four generations. CITES Res. 10.17, *supra* note 153. The definition of “recent lineage” is merely a guideline within the Resolution, however, and one could argue that it should extend for another generation or so, especially in the context of de-extinct species. *See id.*

however, protect at least some de-extinct species for a few generations if they were to qualify as hybrids.¹⁵⁶

Regardless of how de-extinct species might be classified or listed under CITES, the convention would not protect de-extinct species from all threats. While the convention would at least help to control international trade in specimens of listed de-extinct species, it would not offer comprehensive regulation or protection of de-extinct species. More than just international trade will affect de-extinct species; therefore, the international community needs to consider how other treaties or agreements may apply to de-extinct species.

2. *The CMS: How to Protect Those De-extinct Species Who Wander*

a. *Background about the CMS*

The CMS,¹⁵⁷ which currently has 124 parties, was concluded in 1979 and entered into force on November 1, 1983.¹⁵⁸ The CMS focuses on conserving those wild animal species that migrate across national boundaries—“migratory species.”¹⁵⁹ The term “migratory species” is defined as “the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.”¹⁶⁰ The CMS is a framework (or umbrella) convention; this means that it creates a structure or basis for the establishment of other more specific agreements or instruments, which may range from legally binding to informal.¹⁶¹ There are currently seven agreements and nineteen memoranda of understanding that have been concluded in the CMS family.¹⁶² These agreements and memoranda focus on the protection of a single species or a group of species¹⁶³ and cover

156. CITES Resolution 13.10 also might be pertinent to de-extinct species because some de-extinct species might act as invasive alien species. See CITES, Resolution Conf. 13.10 (Rev. CoP14), Trade in Alien Invasive Species (2004). If that is the case, the focus will necessarily and rightfully be less on protecting de-extinct species and more on regulating and controlling them to protect the environment from their adverse effects. See CITES, *supra* note 76, art. XI(3); *CITES Resolutions*, CITES, <https://cites.org/eng/res/intro.php> (last visited Feb. 6, 2016).

157. Convention on the Conservation of Migratory Species of Wild Animals, June 23, 1979, 1651 U.N.T.S. 333 [hereinafter CMS].

158. *Parties and Range States*, CMS, <http://www.cms.int/en/parties-range-states> (last visited Sept. 3, 2016); CMS, *CMS History and Structure*, in CMS FAMILY GUIDE, at 1 (4th ed. 2015). The United Nations Environment Programme coordinates the CMS Secretariat. *About the CMS Secretariat*, CMS, <http://www.cms.int/about/secretariat> (last visited Apr. 25, 2016); see also CMS, *supra* note 157, art. IX (explaining the CMS Secretariat's functions).

159. CMS, *supra* note 157, art. I.

160. *Id.* art. I(1)(a).

161. CMS, CMS, <http://www.cms.int/en/legalinstrument/cms> (last visited Feb. 6, 2016).

162. See *Agreements*, CMS, <http://www.cms.int/en/cms-instruments/agreements> (last visited Sept. 3, 2016); *Memoranda of Understanding*, CMS, <http://www.cms.int/en/cms-instruments/mou> (last visited Sept. 3, 2016).

163. For example, the Aquatic Warbler Memorandum of Understanding seeks to protect the aquatic warbler, *Acrocephalus paludicola*. *Aquatic Warbler*, CMS, <http://www.cms.int/en/legalinstrument/aquatic-warbler> (last visited Feb. 6, 2016). The Memorandum of Understanding for the

species such as gorillas, European bats, sharks, West African elephants, and High Andean flamingos.¹⁶⁴

Among other things, the CMS Parties agree to protect endangered migratory species (which are listed in CMS Appendix I) and to try to enter into agreements to conserve and manage those migratory species whose conservation status is “unfavorable”¹⁶⁵ (which are listed in Appendix II).¹⁶⁶ For endangered migratory species in Appendix I,¹⁶⁷ “nations that exercise[] jurisdiction over any part of the range of that migratory species” (known as “Range States”)¹⁶⁸ should try to conserve and restore important habitats for those species, prevent or minimize the negative effects of activities that impede or preclude the species’ migration, and prevent or reduce circumstances that endanger the species.¹⁶⁹ Importantly, Range States must prohibit the taking¹⁷⁰ of endangered species listed in Appendix I (such as the snow leopard and the bowhead whale), except in limited circumstances.¹⁷¹ For migratory species listed in Appendix II, which are those whose conservation status is unfavorable (such as the mountain gorilla and the longfin mako shark),¹⁷² Range States are encouraged to enter into agreements to restore those species to a favorable conservation status.¹⁷³ The text of the CMS also includes requirements and suggestions regarding the content of those agreements.¹⁷⁴

Conservation of Cetaceans and Their Habitats in the Pacific Islands Region addresses cetacean populations in the Pacific Islands Region. *Pacific Islands Cetaceans*, CMS, <http://www.cms.int/en/legalinstrument/pacific-islands-cetaceans> (last visited Feb. 6, 2016).

164. *Agreements*, *supra* note 162; *Memoranda of Understanding*, *supra* note 162.

165. A species’ conservation status is unfavourable if any of the following conditions is not met:

- (1) population dynamics data indicate that the migratory species is maintaining itself on a long-term basis as a viable component of its ecosystems;
- (2) the range of the migratory species is neither currently being reduced, nor is likely to be reduced, on a long-term basis;
- (3) there is, and will be in the foreseeable future, sufficient habitat to maintain the population of the migratory species on a long-term basis; and
- (4) the distribution and abundance of the migratory species approach historic coverage and levels to the extent that potentially suitable ecosystems exist and to the extent consistent with wise wildlife management.

CMS, *supra* note 157, art. I(1)(c)–(d) (spelling of unfavorable in text of the Article modified from British English to American English).

166. *Id.* art. II(3).

167. *Species*, CMS, <http://www.cms.int/en/species> (last visited Feb. 6, 2016).

168. “‘Range State’ in relation to a particular migratory species means any State (and where appropriate any other Party referred to under sub-paragraph (k) of this paragraph) that exercises jurisdiction over any part of the range of that migratory species, or a State, flag vessels of which are engaged outside national jurisdictional limits in taking that migratory species.” CMS, *supra* note 157, art. I(1)(h).

169. *See id.* art. III(4)–(5).

170. “Taking” is defined somewhat broadly as “taking, hunting, fishing, capturing, harassing, deliberate killing, or attempting to engage in any such conduct.” CMS, *supra* note 157, art. I(1)(i).

171. *See id.* art. III(4)–(5). This is a significant requirement that could greatly benefit a de-extinct species listed in Appendix I because there could be no taking of the de-extinct species.

172. *Species*, *supra* note 167.

173. *See CMS*, *supra* note 157, arts. IV(3), V(1).

174. *See id.* art. V(4)–(5).

b. *The CMS and De-extinction*

As a threshold matter, for a de-extinct species to be protected under the CMS, the species would need to be considered a migratory species and would need to be listed in either Appendix I or Appendix II.¹⁷⁵ The range and potential migratory nature of some extinct species is not well known, but some candidate species for de-extinction might qualify as migratory species after they have been introduced into the wild; for example, although passenger pigeons did not migrate,¹⁷⁶ a population of passenger pigeons could perhaps cyclically and predictably cross the border between the United States¹⁷⁷ and Canada if the population were initially introduced into an area close enough to the border. Some de-extinct species, however, would not qualify as migratory species and thus would not be affected or potentially protected by the CMS or its agreements or memoranda—a gap that will need to be filled by other treaties or agreements.

Assuming *arguendo* that a certain de-extinct species is wild and migratory (or, at a minimum, crosses national borders because of where it is reintroduced), then initially it is conceivable that the de-extinct species might qualify for listing in Appendix I because the species could be in “danger of extinction throughout all or a significant portion of its range” due to its small introductory population.¹⁷⁸ A de-extinct species also could have an unfavorable conservation status and be eligible for listing in Appendix II, especially because the data necessary under the first condition for a favorable conservation status (“population dynamics data indicate that the migratory species is maintaining itself on a long-term basis as a viable component of its ecosystems”)¹⁷⁹ probably would be lacking.

But even if a de-extinct species were considered migratory and listed in one of the two Appendices, much like CITES, the CMS would not, in and of itself, provide comprehensive protection to the de-extinct species—further support within the international legal framework would be needed. If the de-extinct species were listed in Appendix I, the CMS would encourage Range States to conserve its important habitats, prevent or reduce activities that have negative effects on the de-extinct species’ migration route, and reduce factors that endanger the species. Significantly, Range States for that de-extinct species would be required to prohibit the taking of an Appendix I de-extinct species

175. CMS Appendix II may also include “those [species] which have a conservation status which would significantly benefit from the international co-operation that could be achieved by an international agreement.” CMS, *supra* note 157, art. IV(1). A de-extinct species could qualify for protection under the CMS this way.

176. SHAPIRO, *supra* note 7, at 172.

177. The United States actually is not a Party to the CMS, but it is a signatory to some of the instruments in the CMS family. *See Parties and Range States, supra* note 158.

178. CMS, *supra* note 157, art. I(1)(e); *see also* CMS, APPLICATION OF THE IUCN RED LIST CATEGORIES TO EVALUATE CMS LISTING PROPOSALS (2011) (discussing the requirements for Appendix I).

179. CMS, *supra* note 157, art. I(1)(c)(1).

except in rare, specified circumstances. Such a prohibition on taking could provide a meaningful measure of protection for a de-extinct species; however, with the notable exception of the prohibition on taking the species, Range States are not *required* to do anything and instead should “endeavor”¹⁸⁰ to undertake the above actions. Similarly, if the de-extinct species were listed in Appendix II, the Range States should “endeavor”¹⁸¹ to enter into agreements to protect the species. Yet again, not much is truly mandated, and a separate agreement or memorandum of understanding (or similar document) would have to be crafted to provide additional protections for the de-extinct species under the CMS framework. Any such agreement or memorandum could be tailored specifically toward a particular migratory de-extinct species.¹⁸²

Unfortunately, even if Range States entered into an agreement to protect a de-extinct species (or a population of a de-extinct species), the CMS covers migratory species, and the convention’s coverage of de-extinct species would be limited to those that migrate and further circumscribed to those countries that are Range States and that agree to be parties to any CMS de-extinct species agreement or memorandum. Any protections would be limited to the provisions of the agreement or memorandum that might be created for a de-extinct species, and such an agreement or memorandum might not even be legally binding.¹⁸³

The CMS framework could, at most, provide an additional measure of protection for those de-extinct species that are migratory and that are listed in a CMS Appendix. These limitations likely would preclude protections under the CMS for many, if not most, de-extinct species, and once again, the overall level of international protection or regulation of de-extinct species would be incomplete and inconsistent.

180. *See id.* art. III(4) (providing that “Parties that are Range States of a migratory species listed in Appendix I shall *endeavour*” to do certain conservation actions) (emphasis added) (spelling of endeavor in text of the Article modified from British English to American English).

181. *See id.* art. IV(3) (stating that “Parties that are Range States of migratory species listed in Appendix II shall *endeavour* to conclude AGREEMENTS where these should benefit the species and should give priority to those species in an unfavourable conservation status”) (emphasis added).

182. As noted above, there are seven agreements and nineteen memoranda of understanding that have been entered into under the auspices of the UNEP/CMS Secretariat. *See Agreements, supra* note 162; *Memoranda of Understanding, supra* note 162. These documents may cover many species; for example, the Agreement on the Conservation of African-Eurasian Migratory Waterbirds covers over 250 species. UNEP/AEWA Secretariat, *Species*, <http://www.unep-aewa.org/en/species> (last visited June 6, 2016). For assessments of some of the strengths and weaknesses of the CMS, see Elizabeth A. Baldwin, Note, *Twenty-Five Years under the Convention on Migratory Species: Migration Conservation Lessons from Europe*, 41 ENVTL. L. 535 (2011); Nele Matz, *Chaos or Coherence? – Implementing and Enforcing the Conservation of Migratory Species through Various Legal Instruments*, 65 ZaöRV 197 (2005).

183. Many of the instruments in the CMS family are, by their own terms, not legally binding on the signatories. *See, e.g.*, Memorandum of Understanding on the Conservation of Migratory Sharks § 1(1) (Feb. 12, 2010); Memorandum of Understanding Concerning Conservation Measures for the West African Populations of the African Elephant (*Loxodonta africana*) ¶ 8 (Nov. 23, 2005).

3. *The CBD: Possible Protections and Regulations for De-extinct Species, Crippled by Caveats*

a. *History and Overview of the CBD*

In 1992, the CBD¹⁸⁴ was opened for signature, and it entered into force on December 29, 1993.¹⁸⁵ The CBD has been widely accepted worldwide and currently has 196 parties.¹⁸⁶ As the name implies, the CBD addresses “the conservation and sustainable use of biological diversity,” as well as the equitable sharing of the benefits of biodiversity.¹⁸⁷ Pursuant to the substantive provisions of the CBD, the Parties shall develop new, or adapt existing, national plans and programs to address the conservation and sustainable use of biological diversity,¹⁸⁸ identify and monitor the components of biological diversity that are important for the conservation and sustainable use of biological diversity,¹⁸⁹ and identify and monitor activities that adversely impact biodiversity conservation and sustainable use (or are likely to do so).¹⁹⁰

b. *The CBD and De-extinction*

The preceding actions required by the CBD could be applicable to de-extinct species, as de-extinct species unquestionably would fall within the definition of biological diversity. The CBD defines “biological diversity” as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.”¹⁹¹ This definition (as well as the concept of biological diversity in general) is necessarily broad and certainly would include de-extinct species, just as it includes other species. So the CBD could provide protections to de-extinct species based on their membership in the broader class of biodiversity. Although unnecessary, de-extinct species also could qualify as “biological resources,” which are “genetic resources, *organisms* or parts thereof, *populations*, or any other biotic component of ecosystems with actual or potential use or value for humanity.”¹⁹² Moral and ethical debates aside, de-extinct species will be organisms and/or populations that will be valuable and

184. Convention on Biological Diversity, June 5, 1992, 1760 U.N.T.S. 79 [hereinafter CBD].

185. *History of the Convention*, CBD, <https://www.cbd.int/history/> (last visited Feb. 6, 2016).

186. *List of Parties*, CBD, <https://www.cbd.int/information/parties.shtml> (last visited Sept. 3, 2016). The CBD Secretariat supports the convention and is located in Montreal, Canada. *The CBD Secretariat: Role*, CBD, <https://www.cbd.int/secretariat/role.shtml> (last visited Apr. 25, 2016); see also CBD, *supra* note 184, art. 24 (establishing the Secretariat and describing its functions).

187. *History of the Convention*, *supra* note 185.

188. CBD, *supra* note 184, art. 6(a).

189. *Id.* art. 7(a)–(b).

190. *Id.* art. 7(c).

191. *Id.* art. 2.

192. *Id.* (emphasis added).

useful for humanity on many levels, thus qualifying them as “biological resources” for purposes of the CBD.

The CBD Parties must take measures for *in situ*¹⁹³ and *ex situ*¹⁹⁴ conservation of biological diversity, several of which could include de-extinct species.¹⁹⁵ For example, in the context of *in situ* conservation, the provisions that could be relevant to de-extinct species include requiring Parties to establish and manage protected areas; to regulate biological resources that are important to conserving biological diversity; to maintain viable species populations in natural settings; to “promote the recovery of threatened species”; to prevent, control, or eradicate alien species¹⁹⁶ that threaten ecosystems or other species; and “[w]here a significant adverse effect on biological diversity has been determined . . . , [to] regulate or manage the relevant processes and categories of activities.”¹⁹⁷ Regarding *ex situ* conservation, one provision that could affect de-extinct species requires the Parties to “[a]dopt measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions.”¹⁹⁸ Further, Parties are supposed to consider “the conservation and sustainable use of biological resources” in their national decisions and “[a]dopt measures relating to the use of biological resources to avoid or minimize adverse impacts on biological diversity.”¹⁹⁹ Additionally, de-extinct species may be affected by the impact assessment provisions in Article 14, which require Parties to “[i]ntroduce appropriate procedures requiring environmental impact assessment of [their] proposed projects that are likely to have significant adverse effects on biological diversity.”²⁰⁰ Specifically, such impact assessments should be used when determining whether and where to introduce a de-extinct species into the environment.

193. “‘In-situ conservation’ means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.” *Id.*

194. “‘Ex-situ conservation’ means the conservation of components of biological diversity outside their natural habitats.” *Id.*

195. *Id.* art. 7.

196. Indeed, some de-extinct species could end up as invasive alien species, especially if their reintroduction is not carefully assessed and managed. The CBD Parties often address issues related to invasive alien species and have adopted many decisions on the topic. *See, e.g.*, Conference of the Parties to the CBD, Pyeongchang, S. Kor., Oct. 6–17, 2014, *COP 12 Decision XII/17: Invasive Alien Species: Review of Work and Considerations for Future Work*, UNEP/CBD/COP/DEC/XII/17 (Oct. 17, 2014); Conference of the Parties to the CBD, Pyeongchang, S. Kor., Oct. 6–17, 2014, *COP 12 Decision XII/16: Invasive Alien Species: Management of Risks Associated with Introduction of Alien Species as Pets, Aquarium and Terrarium Species, and as Live Bait and Live Food, and Related Issues*, UNEP/CBD/COP/DEC/XII/16 (Oct. 17, 2014); Conference of the Parties to the CBD, Hyderabad, Ind., Oct. 8–19, 2012, *COP 11 Decision XI/28: Invasive Alien Species*, UNEP/CBD/COP/DEC/XI/28 (Dec. 5, 2012). These and other CBD decisions and documents regarding invasive alien species should be considered for de-extinct species.

197. CBD, *supra* note 184, art. 8(l).

198. *Id.* art. 9(c).

199. *Id.* art. 10(b).

200. *Id.* art. 14(a).

All of the above provisions could be construed to include de-extinct species and bring de-extinct species within the purview of the CBD. Much like the CMS, however, the potential protections and regulations within the CBD will fall far short of providing comprehensive, tailored coverage for de-extinct species. First, most of the CBD's substantive provisions contain limiting language that requires the Parties to comply only "as far as possible and as appropriate" or "in accordance with [their] particular conditions and capabilities."²⁰¹ As such, there are few concrete mandates within the CBD. Further, the CBD is not directed toward particular species. While the convention does focus on the conservation of biological diversity (which undoubtedly would include de-extinct species), the CBD is not, and should not be, tailored toward de-extinct species. Unfortunately, the CBD's general provisions might fail to fully address the unique situations related to de-extinct species, largely because of the caveats and limiting language in the CBD and because the convention broadly covers biodiversity generally, rather than providing specific protections for particular species. Despite the fact that the CBD provides a set of general principles that could apply to de-extinct species, similar to CITES and the CMS, the CBD alone will be inadequate to regulate and protect de-extinct species.

B. Regulating De-extinct Species as Genetically Modified Organisms

The preceding subpart focused on treaties that would be used primarily to protect de-extinct species, but de-extinct species also will need to be regulated to ensure that they do not harm other species, the environment, or humans.²⁰² One way to limit such harm is to regulate de-extinct species as genetically modified organisms.²⁰³ This subpart analyzes how de-extinct species might be treated internationally as genetically modified organisms.

1. The CBD: Brief Lip Service to Regulating Genetically Modified Organisms

The CBD contains several provisions that address living modified organisms (LMOs). Article 8(g) provides that the Parties shall "[e]stablish or maintain means to regulate, manage or control the risks associated with the use

201. See, e.g., *id.* arts. 6, 8, 9.

202. See, e.g., O'CONNOR, *supra* note 57, at 197 (suggesting that to some, "the passenger pigeon was a destructive force in nineteenth-century America"); Anne I. Myhr & Bjorn K. Myskja, *From Protection to Restoration: A Matter of Responsible Precaution*, in *THE ETHICS OF ANIMAL RE-CREATION AND MODIFICATION: REVIVING, REWILDING, RESTORING* 117, 122–23 (Markku Oksanen & Helena Siipi eds., 2014) (explaining some concerns about genetically modified organisms ("GMOs") and how de-extinct species are analogous to GMOs and invasive species).

203. See SHAPIRO, *supra* note 7, at 181–87 (discussing how de-extinct species could be regulated as genetically modified organisms); Myhr & Myskja, *supra* note 202, at 122–23 (analogizing de-extinct species to GMOs). Countries vary in how they treat genetically modified organisms nationally. See Library of Congress, *Restrictions on Genetically Modified Organisms*, <http://www.loc.gov/law/help/restrictions-on-gmos/> (last updated June 9, 2015).

and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity.”²⁰⁴ De-extinct species are the embodiment of “living modified organisms,” and as such, the countries that are parties to the CBD will be responsible for their management.

Article 19 also discusses living modified organisms. Paragraph (3) provides that “[t]he Parties shall consider the need for and modalities of a protocol setting out appropriate procedures, including, in particular, advance informed agreement, in the field of the safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity.”²⁰⁵ Paragraph (4) states that “[e]ach Contracting Party shall . . . provide any available information about the use and safety regulations required by that Contracting Party in handling such organisms, as well as any available information on the potential adverse impact of the specific organisms concerned to the Contracting Party into which those organisms are to be introduced.”²⁰⁶ Article 19 led to the creation of the Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Cartagena Protocol), which almost certainly will apply to the introduction and transfer of de-extinct species.

2. *The Cartagena Protocol: More Focused and Thorough Regulation of Genetically Modified Organisms*

The Cartagena Protocol,²⁰⁷ entered into under the auspices of the CBD, is another multilateral environmental agreement that could have consequences for de-extinct species within the international legal framework. The Cartagena Protocol “aims to ensure the safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity, taking also into account risks to human health.”²⁰⁸ It seeks to protect existing biodiversity by establishing procedures regarding the transboundary movements of LMOs that could negatively affect biodiversity.²⁰⁹ The Cartagena Protocol is the only international agreement that

204. CBD, *supra* note 184, art. 8(g). The Cartagena Protocol directly addresses this and is discussed further below.

205. *Id.* art. 19(3).

206. *Id.* art. 19(4).

207. Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Jan. 29, 2000, 2226 U.N.T.S. 208 [hereinafter Cartagena Protocol].

208. *The Cartagena Protocol on Biosafety*, CBD, <https://bch.cbd.int/protocol> (last updated Aug. 15, 2016). Genetically modified agricultural crops, such as tomatoes and corn, are a common example of an LMO. *Frequently Asked Questions (FAQs) on the Cartagena Protocol*, CBD, http://bch.cbd.int/protocol/cpb_faqs.shtml#faq3 (last updated Feb. 29, 2012).

209. *About the Protocol*, CBD, <https://bch.cbd.int/protocol/background/> (last updated May 29, 2012).

focuses on protecting biodiversity from the potential threats caused by biotechnology.²¹⁰

a. Overview of the Cartagena Protocol

The Cartagena Protocol is one of the CBD's supplementary agreements.²¹¹ Through CBD Decision II/5, the CBD Parties established an Open-ended Ad Hoc Working Group on Biosafety to draft the Protocol, which the working group accomplished over the course of six meetings from 1996 to 1999.²¹² Adopted in January 2000, the Cartagena Protocol entered into force on September 11, 2003, and currently has 170 parties.²¹³

The Cartagena Protocol sets out two main procedures regarding the import and export of LMOs. One procedure, the advance informed agreement (AIA) procedure, addresses situations in which the LMOs are to be introduced directly into the environment of the importing country for the first time.²¹⁴ The AIA procedure allows for countries to make informed decisions as to whether they will import LMOs.²¹⁵ Pursuant to the AIA procedure, before an LMO is intentionally moved from one country to another, the exporting Party must provide notification to the importing Party, which is required to respond by sending a specific acknowledgement of receipt.²¹⁶ The importing Party must then undertake a risk assessment²¹⁷ and make a decision²¹⁸ (either according to its own domestic regulatory framework or according to the procedure provided in the Cartagena Protocol) as to whether the intentional transboundary movement of the LMO from the exporting Party to the importing Party is acceptable.²¹⁹ As explained below, the AIA procedure could apply directly to certain de-extinct specimens.

210. Debra M. Strauss, *The International Regulation of Genetically Modified Organisms: Importing Caution into the U.S. Food Supply*, 61 *FOOD & DRUG L.J.* 167, 177 (2006).

211. *About the Protocol*, *supra* note 209.

212. *Id.*

213. *The Cartagena Protocol on Biosafety*, *supra* note 208.

214. *See* Cartagena Protocol, *supra* note 207, art. 7(1); *The Cartagena Protocol on Biosafety, and Its Nagoya—Kuala Lumpur Supplementary Protocol on Liability and Redress*, CBD, <https://www.cbd.int/undb/media/factsheets/undb-factsheet-biosafety-en.pdf> (last visited Aug. 5, 2016). The AIA procedure does not apply if the Conference of the Parties decides that a particular movement of LMOs from one country to another is not likely to affect biodiversity negatively. Cartagena Protocol, *supra* note 207, art. 7(4).

215. *About the Protocol*, *supra* note 209.

216. *See* Cartagena Protocol, *supra* note 207, arts. 8, 9.

217. The risk assessment must be in accordance with Annex III of the Protocol. *See id.* arts. 10(1), 15, annex III.

218. The importing Party may prohibit the import, approve it with conditions, approve it without conditions, request additional information, or extend the period of time during which it will notify the exporting Party of its decision. *Id.* art. 10(3).

219. *See id.* arts. 9, 10. The Cartagena Protocol establishes specific timeframes during which the importing Party must communicate its decision, but a failure to communicate a decision within the allotted times does not imply the importing Party's consent to the movement. *See id.* The Protocol includes a simplified procedure in Article 13, by which an importing Party may notify the Biosafety Clearing-House in advance about which LMO imports are exempted from the AIA procedure and about

The second main procedure addresses situations in which LMOs are “intended for direct use as food or feed, or for processing” (the “LMOs-FFP procedure”).²²⁰ Pursuant to the LMOs-FFP procedure, if a Party decides to allow LMOs to be used domestically (including allowing LMOs to be placed on the market), and if those LMOs “may be subject to transboundary movement for direct use as food or feed, or for processing,” the Party must provide specific²²¹ information about its risk assessment and decision to the Biosafety Clearing-House.²²² The Clearing-House was established by the Cartagena Protocol to facilitate information exchange regarding LMOs.²²³ It seems quite improbable that specimens of de-extinct species would be “intended for direct use as food or feed, or for processing” because that would be at odds with the goal of introducing them into the wild and preserving them;²²⁴ therefore, the LMOs-FFP procedure probably would not be applicable to de-extinct species. As noted above and discussed further below, however, the AIA procedure likely would apply to de-extinct species.

b. The Cartagena Protocol and De-extinction

Living specimens of some de-extinct species very likely would qualify as “living modified organisms” and thus be subject to the Cartagena Protocol’s restrictions. The Cartagena Protocol defines a “living modified organism” as “any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology.”²²⁵ “Modern biotechnology” is further defined as “the application of . . . [i]n vitro nucleic acid techniques . . . or . . . [f]usion of cells beyond the taxonomic family, that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection.”²²⁶ Indeed, certain specimens of a de-extinct species would be the epitome of “living modified organisms”—they would be living organisms²²⁷ with novel genetic material that were resurrected through modern biotechnology (like cloning and

cases in which the exporting Party may continue with the movement of the LMO at the same time as the exporting Party notifies the importing Party. *Id.* art. 13.

220. *The Cartagena Protocol on Biosafety, and Its Nagoya—Kuala Lumpur Supplementary Protocol on Liability and Redress, supra* note 214.

221. The Party must provide the information specified in Annex II of the Cartagena Protocol. Cartagena Protocol, *supra* note 207, art. 11(1).

222. *Id.*

223. *About the Protocol, supra* note 209. The Clearing-House helps countries to implement the Cartagena Protocol. *Id.*

224. If a de-extinct species were to become so abundant in the wild that it no longer required stringent protections, then perhaps it could be used for food, and the LMOs-FFP procedure might apply. This, however, seems unlikely to happen in the near future.

225. Cartagena Protocol, *supra* note 207, art. 3(g).

226. *Id.* art. 3(i).

227. “‘Living organism’ means any biological entity capable of transferring or replicating genetic material, including sterile organisms, viruses and viroids.” *Id.* art. 3(h).

genetic engineering). As such, many de-extinct specimens could meet the Cartagena Protocol's definition of LMOs.

Not all specimens of de-extinct species will be covered by the definition of LMOs, however. The last clause in the definition of "modern biotechnology" likely would exclude specimens of de-extinct species that are created through selective back-breeding or mating. The definition excludes "techniques used in traditional breeding and selection"; accordingly, those specimens born as the result of selective mating techniques would be excluded from the Cartagena Protocol, as selective mating is a common breeding method that has been used by humans to strengthen certain characteristics in plants and animals for millennia.²²⁸

For those specimens of de-extinct species that qualify as LMOs, however, the Cartagena Protocol, through its AIA procedure, could provide another level of protection and regulate the introduction of de-extinct species into the wild. In terms of protection, the Cartagena Protocol would indirectly protect some specimens of de-extinct species by ensuring that their transboundary movement is carefully controlled. For purposes of regulation, the Cartagena Protocol's provisions could assuage some of the concerns regarding the possible negative effects of de-extinct species on other species and ecosystems. The Protocol would require importing countries to evaluate the risks before allowing the transboundary movement and intentional introduction of de-extinct specimens (that qualify as LMOs) into the wild.²²⁹

The Cartagena Protocol adds another regulatory procedure that would need to be followed before de-extinct specimens could be introduced into the wild, and it could be used as a mechanism by which the introduction of de-extinct specimens might be prevented or restricted. It is conceivable that for those who argue that de-extinction should not occur because of the potentially negative effects on biodiversity, the Cartagena Protocol could be used to underscore that concern and preclude or constrain introduction of de-extinct

228. RUTH MACKENZIE ET AL., IUCN ENVTL. L. CTR., AN EXPLANATORY GUIDE TO THE CARTAGENA PROTOCOL ON BIOSAFETY 5–6, 246 (2003).

229. The Nagoya–Kuala Lumpur Supplementary Protocol on Liability and Redress provides specific response measures that Parties should take if there is damage to biodiversity due to LMOs and provides for redress in certain instances. *See id.* at 12–14; *see also The Nagoya–Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety*, CBD, <https://bch.cbd.int/protocol/supplementary/> (last updated May 7, 2015). The idea behind the Supplementary Protocol "is that the polluter must pay for any damage caused." Library of Congress, *Restrictions on Genetically Modified Organisms: International Protocols*, <http://www.loc.gov/law/help/restrictions-on-gmos/international-protocols.php> (last updated June 9, 2015). The Supplementary Protocol has not yet entered into force. *The Cartagena Protocol on Biosafety, and Its Nagoya–Kuala Lumpur Supplementary Protocol on Liability and Redress*, *supra* note 214; *Parties to the Protocol and Signature and Ratification of the Supplementary Protocol*, CBD, <https://bch.cbd.int/protocol/parties/#tab=1> (last visited Aug. 5, 2016). Once the Supplementary Protocol enters into force, which may be soon, it could be relevant to de-extinct species. For example, if a de-extinct species were moved from one country to another in accordance with the Cartagena Protocol and caused damage to biodiversity, the Supplementary Protocol could address which response measures would need to be taken and whether one Party would be liable for redress.

species into the wild in some instances. Even if the Cartagena Protocol does not prevent the introduction of de-extinct specimens, it could help to ensure that countries properly evaluate the risks of introducing de-extinct specimens into the environment.

The Cartagena Protocol is one of the most directly applicable international treaties or agreements for de-extinct species; however, even assuming that the Cartagena Protocol's provisions could benefit or regulate certain de-extinct species (because the provisions would require countries to consider the potential risks of the transboundary movement and introduction of LMOs into the environment), the Cartagena Protocol would apply inconsistently at best to de-extinct species. The Protocol would be applicable to some specimens of de-extinct species that result from cloning and genetic engineering, but it would not apply to de-extinct specimens that are created through selective back-breeding or mating. It also would apply mainly in the context of intentional transboundary movement and introduction of de-extinct species into the wild. Yet again, de-extinct species would be subject to a variable and incomplete regulatory framework under international law.

C. "Protecting" and Regulating De-extinct Species as Intellectual Property

Whether living organisms are patentable varies from country to country and is an unsettled issue even within many countries.²³⁰ Patent²³¹ laws apply nationally or regionally, so the patentability of living organisms, and more specifically, of de-extinct species,²³² will vary across different countries.²³³

230. See generally Swedlow, *supra* note 38 (discussing patentability of living organisms in the U.S.); see also *Bioethics and Patent Law: The Case of the Oncomouse*, WIPO MAGAZINE (June 2006), http://www.wipo.int/wipo_magazine/en/2006/03/article_0006.html. For example, India and China exclude plant and animal varieties from patentability, whereas the United States has allowed some animals, such as the Harvard Oncomouse, to be patented. *Introduction to Patents*, U.S. EMBASSY NEW DELHI, INDIA, <http://newdelhi.usembassy.gov/iprpatents.html> (last visited Feb. 6, 2016); *Patent*, U.S. EMBASSY, BEIJING, CHINA, <http://beijing.usembassy-china.org.cn/iprpatent.html> (last visited Feb. 6, 2016); Swedlow, *supra* note 38, at 188; World Intell. Prop. Org., *What Is Intellectual Property?*, <http://www.wipo.int/about-ip/en/> (last visited July 7, 2016); see also DONALD BRUCE & ANN BRUCE, *ENGINEERING GENESIS: THE ETHICS OF GENETIC ENGINEERING IN NON-HUMAN SPECIES* 219–20 (2013) (explaining the United States' approach to patents and genetically modified organisms, including the Harvard Oncomouse, and discussing the ethical issues involved in patenting living organisms); Emma Barraclough, *What Myriad Means for Biotech*, WIPO MAGAZINE (Aug. 2013), http://www.wipo.int/wipo_magazine/en/2013/04/article_0007.html (discussing the Harvard Oncomouse and other key cases related to patents and biotechnology). In *Diamond v. Chakrabarty*, the Supreme Court of the United States held that a "human-made, genetically engineered bacterium" was patentable subject matter. 447 U.S. 303, 306, 310 (1980).

231. "A patent is an exclusive right granted for an invention, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem." *Patents: What Is a Patent?*, WIPO MAGAZINE, <http://www.wipo.int/patents/en/> (last visited Feb. 10, 2016).

232. For an analysis of whether de-extinct species will be patentable in the United States, see Swedlow, *supra* note 38.

Generally, for something to be patentable, it must be novel, useful, and non-obvious.²³⁴ In at least some countries, it is quite plausible that de-extinct species could be patented and protected as intellectual property, but it is likely that other countries will not allow de-extinct species to be patented.

The patentability of de-extinct species will be determined primarily by national laws and policies, but several international treaties related to intellectual property and patents should be considered. The Paris Convention for the Protection of Industrial Property was adopted in 1883 and was the first international treaty regarding intellectual property, including patents.²³⁵ It addresses national treatment, mandates the right of priority for patents, and includes common rules that Contracting States are required to follow.²³⁶ The Patent Cooperation Treaty, which was concluded in 1970, provides the procedure by which one may file a single “international” application for a patent rather than filing separate applications in each country.²³⁷ Under the Patent Cooperation Treaty, International Searching Authorities conduct an international search for relevant patent documents and technical articles, list the search results in a report, and provide a non-binding, written opinion analyzing the potential for patentability.²³⁸ The information assists the applicant in evaluating whether countries will grant a patent.²³⁹ Finally, the Patent Law Treaty, which entered into force in 2005, seeks to harmonize across nations the procedures used at a national and regional level for patents and patent applications.²⁴⁰ For those countries that are parties to the Patent Law Treaty, it provides the maximum requirements that may be imposed by a national or regional patent office.²⁴¹ Although these patent treaties do not contain provisions that will address the substantive issue of whether a de-extinct species is patentable, it will be essential for those who are working on reviving

233. See *Protecting Your Inventions Abroad: Frequently Asked Questions About the Patent Cooperation Treaty (PCT)*, World Intell. Prop. Org., <http://www.wipo.int/pct/en/faqs/faqs.html> (last updated Apr. 2015).

234. See *General Information Concerning Patents*, U.S. Pat. & Trademark Off., <http://www.uspto.gov/patents-getting-started/general-information-concerning-patents> (last updated Oct. 2014).

235. *Patents*, World Intell. Prop. Org., <http://www.wipo.int/patents/en/#laws> (last visited Feb. 6, 2016); *Paris Convention for the Protection of Industrial Property*, WORLD INTELL. PROP. ORG., <http://www.wipo.int/treaties/en/ip/paris/> (last visited Feb. 6, 2016).

236. See *Summary of the Paris Convention for the Protection of Industrial Property (1883)*, World Intell. Prop. Org., http://www.wipo.int/treaties/en/ip/paris/summary_paris.html (last visited Feb. 6, 2016).

237. Patent Cooperation Treaty (June 19, 1970), <http://www.wipo.int/pct/en/texts/articles/atoc.htm>; see *Protecting Your Inventions Abroad: Frequently Asked Questions About the Patent Cooperation Treaty (PCT)*, *supra* note 233. Whether or not a patent is granted remains the province of national patent offices (or regional offices). *Id.*

238. *Id.*

239. *Id.* Applicants also may request supplementary international searches. *Id.*

240. Patent Law Treaty, June 1, 2000, 2340 U.N.T.S. 3, 39 I.L.M. 1047; *Patent Law Treaty (PLT)*, World Intell. Prop. Org., <http://www.wipo.int/treaties/en/ip/plt/> (last visited Feb. 6, 2016).

241. *Patent Law Treaty (PLT)*, *supra* note 240. Contracting Parties may decide to impose requirements that are more favorable to the applicant than those provided for in the treaty. Patent Law Treaty, *supra* note 240, art. 2(1).

de-extinct species to understand how these treaties might affect their de-extinction efforts.

A final intellectual property treaty worth considering in the de-extinction context is the International Convention for the Protection of New Varieties of Plants (known as the “UPOV Convention”), which entered into force in 1968 and has been amended several times.²⁴² The UPOV Convention provides international recognition and protection of plant breeders’ rights and seeks to encourage the development of new plant varieties.²⁴³ Among other things, the extensive UPOV Convention addresses national treatment, specifies the conditions and application requirements for a breeder’s right, and provides the right of priority and the scope of the breeder’s right.²⁴⁴ Although the UPOV Convention would not apply to de-extinct animal species (because the convention applies only to plants), it is useful to consider by analogy, and as discussed below in Part IV.C, it could be used as a model for the international treatment of de-extinct species as intellectual property.

Even assuming that de-extinct species would be patentable, the de-extinct species would be “protected” only as intellectual property. This would be beneficial from the perspective of the people reviving the de-extinct species, but it would not necessarily benefit the de-extinct species themselves. Regardless, the patentability of de-extinct species as intellectual property could affect the processes of de-extinction and is another facet of de-extinction that the international community will need to contemplate.

Although the above international treaties and agreements each could impact de-extinct species to some extent, none provides a comprehensive regulatory and protective framework for de-extinct species. The existing international framework will, at best, provide a patchwork of protections and regulations that treat de-extinct species as the subjects of international trade, as migratory species, as part of biodiversity in general, as genetically modified organisms, as intellectual property, or as something else entirely. In its current form, the international legal framework likely will be ill suited to meet the challenges associated with controlling and safeguarding de-extinct species. Consequently, the international community should consider how to modify the existing framework or create an entirely new framework.

242. See International Convention for the Protection of New Varieties of Plants, Dec. 1, 1961, <http://www.upov.int/export/sites/upov/upovlex/en/conventions/1961/pdf/act1961.pdf> [hereinafter UPOV Convention]. The UPOV Convention was amended in 1972, 1978, and 1991. *UPOV Lex*, UPOV, http://www.upov.int/upovlex/en/upov_convention.html (last visited Feb. 6, 2016).

243. *Overview*, UPOV, <http://www.upov.int/about/en/overview.html> (last visited Feb. 6, 2016); UPOV Convention, *supra* note 242, art. 2.

244. UPOV Convention, *supra* note 242, chs. III, IV.

III. THE PRECAUTIONARY PRINCIPLE: A WILDLY CONTROVERSIAL
BUT USEFUL APPROACH TO ENVIRONMENTAL UNCERTAINTY
AND DE-EXTINCTION

In the context of international environmental law, the precautionary principle (also known as the precautionary approach)²⁴⁵ is a common concept that provides that if there is a threat of serious environmental damage, a lack of scientific certainty should not be used as an excuse for postponing actions that could prevent that damage.²⁴⁶ “[W]ith respect to the environment, we should err on the side of caution; we should resolve uncertainties in favor of the environment.”²⁴⁷ Instead of waiting for scientific certainty, the precautionary approach counsels that actions should be taken to anticipate and avoid the environmental harm in advance.²⁴⁸ By following the precautionary principle, governments may create preventative policies even if the science is incomplete or uncertain.²⁴⁹ This Part explains the precautionary principle and discusses its current role in international treaties and its potential role in shaping how the international community should consider de-extinction.

A. *Explanation of the Precautionary Principle*

Historically, the precautionary principle often has been applied in the context of preventing pollution (for example, controlling and reducing emissions or marine pollution).²⁵⁰ The 1985 Vienna Convention probably was the first treaty to use the term “precautionary measures,” which the Vienna Convention called for in the context of ozone depletion.²⁵¹ Over the years, the precautionary principle has appeared in various forms in numerous international environmental agreements and documents, including the 1992 Rio Declaration on Environment and Development (Rio Declaration) and the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area, among many others.²⁵² There are various definitions of the

245. There is disagreement or inconsistency as to whether it should be called the precautionary approach or the precautionary principle. Rosie Cooney, *From Promise to Practicalities: The Precautionary Principle in Biodiversity Conservation and Sustainable Use*, in BIODIVERSITY & THE PRECAUTIONARY PRINCIPLE 4, 5 (Rosie Cooney & Barney Dickson eds., 2005). Some feel that the term “precautionary principle” is too demanding, while the term “precautionary approach” is more flexible. *Id.* The distinction may be more semantic and not all that meaningful. *Id.*

246. UNITED NATIONS ENVIRONMENT PROGRAMME, TRAINING MANUAL ON INTERNATIONAL ENVIRONMENTAL LAW 30, http://www.unep.org/environmentalgovernance/Portals/8/documents/training_Manual.pdf.

247. Daniel Bodansky, *The Precautionary Principle in US Environmental Law*, in INTERPRETING THE PRECAUTIONARY PRINCIPLE 203, 203 (Timothy, O’Riordan & James Cameron eds., 1994).

248. Cooney, *supra* note 245, at 4–5.

249. DAVID HUNTER, JAMES SALZMAN & DURWOOD ZAELEKE, INTERNATIONAL ENVIRONMENTAL LAW AND POLICY 479 (4th ed. 2011).

250. PHILIPPE SANDS & JACQUELINE PEEL, PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW 219 (3d ed. 2012).

251. *Id.*; see also DAVID HUNTER ET AL., INTERNATIONAL ENVIRONMENTAL LAW AND POLICY 554 (5th ed. 2015).

252. UNITED NATIONS ENVIRONMENT PROGRAMME, *supra* note 246, at 31.

precautionary principle, but Principle 15 of the Rio Declaration provides one often-cited and commonly accepted definition: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."²⁵³ Some versions, such as Principle 15 of the Rio Declaration, require that the threat to the environment be "serious or irreversible," but other iterations are not as stringent.²⁵⁴

Despite its prevalence, the precautionary principle remains controversial because of the disagreement as to its precise meaning and legal status.²⁵⁵ It has been viewed alternatively as an ethical position, an advocacy tool, a legal doctrine, and a guideline for decision making.²⁵⁶ But regardless of the disagreement over its exact definition or status, central to the many iterations of the precautionary principle is the notion of anticipation of possible consequences, which suggests that a long-term approach should be taken for environmental measures and that revisions to those measures should be anticipated based on changes in science.²⁵⁷

B. Applying the Precautionary Principle in the Context of Existing International Treaties and De-extinction

The precautionary principle appears in several of the international treaties that could be used to regulate and protect de-extinct species. CITES, the CMS, the CBD, and the Cartagena Protocol incorporate the precautionary principle, either through the text of the treaties or through their resolutions or other related documents. This subpart discusses the different ways in which these international treaties incorporate the precautionary principle.

1. CITES and the Precautionary Principle

In the context of CITES, the precautionary principle is not stated within the text of the convention, but it is included in Resolution 9.24.²⁵⁸ The introductory section of Resolution 9.24 emphasizes the importance of the

253. *Id.* at 30; U.N. Conference on Environment and Development, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/26/Rev.1 (Vol. I), annex 1 at princ. 15 (Aug. 12, 1992).

254. SANDS & PEEL, *supra* note 250, at 220; *see also* MACKENZIE ET AL., *supra* note 228, at 12 (discussing the precautionary principle and the Cartagena Protocol, and noting that international instruments treat the precautionary principle differently; also explaining the importance of the precautionary principle).

255. UNITED NATIONS ENVIRONMENT PROGRAMME, *supra* note 246, at 30; *see also* MACKENZIE ET AL., *supra* note 228, at 13 (noting the debate surrounding the nature of the precautionary principle, but explaining that the usefulness of the approach is not controversial).

256. Cooney, *supra* note 245, at 6.

257. UNITED NATIONS ENVIRONMENT PROGRAMME, *supra* note 246, at 32.

258. *See* CITES Res. 9.24, *supra* note 97.

precautionary approach and references Principle 15 of the Rio Declaration.²⁵⁹ Resolution 9.24 also states

that, by virtue of the precautionary approach and in case of uncertainty regarding the status of a species or the impact of trade on the conservation of a species, the Parties shall act in the best interest of the conservation of the species concerned and, when considering proposals to amend Appendix I or II, adopt measures that are proportionate to the anticipated risks to the species.²⁶⁰

In fact, Annex 4 of the resolution focuses specifically on precautionary measures that the Parties should contemplate when proposing amendments to Appendix I or Appendix II.²⁶¹

Given that the precautionary principle is already considered within the CITES regime, the precautionary principle should be applied by the CITES Parties in the context of de-extinction to anticipate and provide for the protection and regulation of de-extinct species despite the lack of scientific certainty on de-extinction. As Resolution 9.24 points out, “the Parties shall act in the best interest of the conservation of the species concerned.” Applying the precautionary principle to de-extinct species within the CITES realm would contribute to the long-term conservation and regulation of de-extinct species.

2. *The CMS and the Precautionary Principle*

The text of the CMS does not explicitly include the precautionary principle. This makes sense because the CMS was created before the precautionary principle emerged as a concept in international environmental law.²⁶² The CMS does, however, incorporate the precautionary principle in resolutions and in some of the agreements and memoranda of understanding that have been entered into under the CMS framework.

For example, in Resolution 4.4, the CMS Parties set various priorities, one of which explains that “[f]uture Agreements should incorporate the ‘precautionary principle.’”²⁶³ Additionally, Resolution 7.5, which addresses the issues associated with wind turbines and migratory species, provides that the Parties should “take full account of the precautionary principle in the development of wind turbine plants.”²⁶⁴ One agreement under the CMS framework that addresses the precautionary principle is the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and

259. *Id.*

260. *Id.*

261. *Id.* annex 4.

262. Rosie Cooney, *The Precautionary Principle in Biodiversity Conservation and Natural Resource Management: An Issues Paper for Policy-Makers, Researchers and Practitioners* 14 (IUCN Policy and Global Change Ser. No. 2, 2004).

263. CMS, Strategy for the Future Development of the Convention, Res. 4.4 (June 11, 1994), http://www.cms.int/sites/default/files/document/Res4.4_E_0_0.pdf.

264. CMS, Wind Turbines and Migratory Species, Res. 7.5 (Sept. 24, 2002), http://www.cms.int/sites/default/files/document/RES_7_05_Wind_Turbine_0_0.pdf.

Contiguous Atlantic Area (“ACCOBAMS”).²⁶⁵ Article II(4) of ACCOBAMS expressly states that “the Parties shall apply the precautionary principle.”²⁶⁶ Other CMS instruments that integrate the principle include the African-Eurasian Waterbird Agreement, the Memorandum of Understanding on the Conservation and Management of the Middle-European Population of the Great Bustard,²⁶⁷ and the Agreement on the International Dolphins Conservation Programme.²⁶⁸

The fact that the CMS has incorporated the precautionary principle in its resolutions, agreements, and memoranda lends credence to the notion that the precautionary principle should be one of the concepts applied in the context of the CMS and de-extinction. In particular, if an agreement or memorandum of understanding regarding de-extinct species were to be concluded, it should include the precautionary principle and would thus align with many other CMS instruments.

3. *The CBD, the Cartagena Protocol, and the Precautionary Principle*

The CBD refers to the precautionary principle in the text of the convention and in various decisions. The Preamble to the CBD states, “Where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.”²⁶⁹ CBD Decision XI/11, which is titled “New and Emerging Issues Relating to the Conservation and Sustainable Use of Biodiversity,” incorporates the precautionary principle in two of its five paragraphs.²⁷⁰ The precautionary principle also appears in Decision XII/24, which “[u]rges Parties and invites other Governments to take a precautionary approach” in the context of synthetic biology.²⁷¹

Like the CBD, the Cartagena Protocol expressly refers to the precautionary principle multiple times, and the Preamble to the Protocol reaffirms the principle as it is described in Article 15 of the Rio Declaration.²⁷² The Cartagena Protocol’s expression of the precautionary principle is sort of

265. Cooney, *supra* note 262, at 16.

266. *Id.*; Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic area (ACCOBAMS) art. II(4), Nov. 24, 1996, 36 I.L.M. 777.

267. Cooney, *supra* note 262, at 16–17.

268. *Id.* at 16.

269. CBD, *supra* note 183, pmb1.; *Precautionary Approach*, CBD, <https://www.cbd.int/marine/precautionary.shtml> (last visited Feb. 6, 2016); Secretariat of the Convention on Biological Diversity, *Convention on Biological Diversity*, <https://www.cbd.int/iyb/doc/prints/factsheets/iyb-cbd-factsheet-cbd-en.pdf> (last visited Aug. 5, 2016).

270. Conference of the Parties to the CBD, Hyderabad, Ind., Oct. 8–19, 2012, *Dec. XI/11: New and Emerging Issues Relating to the Conservation and Sustainable Use of Biodiversity*, ¶¶ 3, 4, UNEP/CBD/COP/DEC/XI/11 (Dec. 5, 2012).

271. Conference of the Parties to the CBD, Pyeongchang, S. Kor., Oct. 6–17, 2014, *Dec. XII/24: New and Emerging Issues: Synthetic Biology*, ¶ 3, UNEP/CBD/COP/DEC/XII/24 (Oct. 17, 2014). This particular decision on synthetic biology should be considered to ensure that countries provide proper risk assessment and management of de-extinct species.

272. *About the Protocol*, *supra* note 208; see Cartagena Protocol, *supra* note 207, art. 1.

the flip side of its role in CITES. While CITES uses the precautionary principle to focus on the regulation of trade to protect endangered species, the Cartagena Protocol employs the principle to focus on preventing harm to biological diversity that could be caused by LMOs. The Cartagena Protocol notes that advances in biotechnology might lead to adverse effects on biodiversity and human health, but also recognizes that biotechnology has “great potential” if adequate safety measures are in place to protect the environment and people.²⁷³ Accordingly, Article 2 of the Cartagena Protocol requires Parties to use LMOs “in a manner that prevents or reduces the risks to biological diversity.”²⁷⁴

In the context of the Cartagena Protocol’s AIA procedure, Article 10(6) provides that

[I]ack of scientific certainty . . . regarding the extent of the potential adverse effects of a living modified organism on . . . [biodiversity] . . . shall not prevent that Party from taking a decision . . . with regard to the import of the living modified organism . . . in order to avoid or minimize such potential adverse effects.²⁷⁵

A similar precautionary principle-type provision is provided in Article 11(8) for the LMOs-FFP procedure.²⁷⁶ Additionally, the Protocol’s risk assessment procedure provides that “[I]ack of scientific knowledge or scientific consensus should not necessarily be interpreted as indicating a particular level of risk, an absence of risk, or an acceptable risk.”²⁷⁷ Clearly, the Cartagena Protocol embraces, and is arguably based upon, the precautionary principle.

C. Despite Uncertainty, a Precautionary Approach to De-extinction Should Be Applied

The precautionary principle commonly is used for seemingly broader, more far-reaching issues such as pollution, but the principle can be used in other contexts.²⁷⁸ Applying the principle in the de-extinction context is still meaningful and useful, and indeed, the use of the precautionary principle is growing.²⁷⁹ Biodiversity conservation has been referred to as a “common concern of humankind,”²⁸⁰ and although de-extinction may revive just a few species initially, these species will need to be protected as part of the Earth’s

273. Cartagena Protocol, *supra* note 207, intro.

274. *Id.* art. 2(2).

275. *Id.* art. 10(6).

276. *See id.* art. 11(8).

277. *Id.* annex III(4).

278. The precautionary approach has been applied in contexts other than pollution. *See, e.g.*, Blake Hudson, *A More Cautious Exercise of the Precautionary Principle - The Case of Land Development*, ENVTL. L. PROF BLOG (Jan. 22, 2016), http://lawprofessors.typepad.com/environmental_law/2016/01/a-more-cautious-exercise-of-the-precautionary-principle.html?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+typepad%2FkWG+28Environmental+Law+Prof+Blog%29 (suggesting that the precautionary approach should be used better in the context of land development).

279. *See* MACKENZIE ET AL., *supra* note 228, at 13.

280. CBD, *supra* note 184, pmb1.

biodiversity and regulated to ensure they do not harm the environment or other biodiversity.

CITES, the CMS, the CBD, and the Cartagena Protocol likely will affect and be affected by de-extinction, and given that these treaties already incorporate some form of the precautionary principle, it seems consistent and logical for the precautionary principle (or at least its underlying concepts) to be applied to de-extinction through those treaties. Other treaties, such as the intellectual property treaties discussed in this Article, do not connect as directly to the precautionary principle because those treaties are not international environmental treaties and thus do not focus on potential environmental harms.²⁸¹ Despite this, on the whole, a precautionary approach is critical in the context of de-extinction.

The precautionary approach or its underlying concepts should be applied to the protection *of* de-extinct species and to the protection of biodiversity and the environment *from* de-extinct species. Undoubtedly, people will continue to debate about the moral and ethical issues surrounding de-extinction for decades to come, but the lack of consensus on the ethical issues should not preclude or deter the international community from considering what needs to be done to safeguard and control de-extinct species. Ongoing debates about the morality or ethics of de-extinction should not delay the development of a legal framework to deal with de-extinction. People might not agree about whether we should raise Frankenstein's mammoth, but they should consider the impending realities of de-extinction and employ a forward-looking approach to safeguard de-extinct species and the environment.

IV. HOW THE INTERNATIONAL LEGAL AND POLICY FRAMEWORK COULD BE MADE MORE APPLICABLE TO DE-EXTINCT SPECIES

It is impossible to know exactly how de-extinction will proceed, but the international community should begin to consider how to modify international treaties and other agreements to address de-extinct species. De-extinction revisions will be more plausible and necessary for certain treaties or agreements (such as CITES) than for others (such as the intellectual property

281. The precautionary principle is really a creature of international environmental law, which means that it is not going to be found in the international intellectual property treaties (or even in national intellectual property laws) and probably will not play a role, directly or indirectly, in shaping those treaties for de-extinction. This is of no major consequence, however, because, as explained above, the intellectual property treaties will not have much of a substantive effect on how de-extinct species are treated for intellectual property purposes. See Myhr & Myskja, *supra* note 202, at 127–30 (discussing the debate about the role of the precautionary principle in the context of GMOs). The precautionary principle will be just one of the many facets of the international legal and policy framework for de-extinction.

treaties). This Part suggests ways in which some of the relevant treaties²⁸² and their associated documents could be revised.²⁸³

A. *CITES: A Natural Fit for De-extinction Modifications*

As explained in Part II, CITES might apply to restrict international trade of de-extinct species without revisions. But because the convention and its resolutions were not drafted with de-extinction in mind (and could not have been), several provisions of CITES and its resolutions may be difficult to apply to de-extinct species. CITES does, however, present an opportunity for modifications to address de-extinction. Employing an anticipatory approach (in the same vein as the precautionary principle), there are several ways in which CITES could be altered to address de-extinction more directly.

1. *Amending the Text of the Convention*

The text of the convention has been amended only twice (in relatively minor ways) since CITES went into force in 1975.²⁸⁴ Given this lackluster amendment history (and the difficulty of amending treaties in general), it would be almost impossible to amend the text of CITES to provide for de-extinct species. If it were possible, however, one useful change would be to amend the definition of “species,” which currently means “any species, subspecies, or geographically separate population thereof.”²⁸⁵ The definition as written probably does not exclude de-extinct species, but it could be amended to include de-extinct species explicitly. For example, the “species” definition could be amended to “any species, subspecies, or geographically separate population thereof, *including any currently living species, subspecies, or geographically separate population that was previously extinct.*”

A second change could be to amend Article VII(4), which provides that an Appendix I animal specimen that is “bred in captivity for commercial

282. Of the international treaties and agreements discussed in this Article, CITES and the Cartagena Protocol are perhaps the most directly applicable to de-extinction in their current forms.

283. Of course, any treaty or agreement that might address de-extinct species will apply only to those countries that are parties to the agreement. If some countries are not parties to relevant treaties that relate to de-extinct species, then non-binding memoranda or similar documents could be considered as an alternative or additional option. National laws also will play an important role and could help to bolster (or fill gaps in) the international legal framework.

284. See CITES, *supra* note 76; *What Is CITES?*, *supra* note 77. The Bonn Amendment took almost eight years to enter into force on April 13, 1987. *Bonn Amendment to the Text of the Convention*, CITES, <https://www.cites.org/eng/disc/bonn.php> (last visited Feb. 6, 2016). The Gaborone Amendment took over 30 years to enter into force on November 29, 2013. *Gaborone Amendment to the Text of the Convention*, CITES, <https://www.cites.org/eng/disc/gaborone.php> (last visited Feb. 6, 2016). To amend the text of the convention, at least one-third of the CITES Parties must request the amendment, and the Secretariat must then convene “[a]n extraordinary meeting of the Conference of the Parties.” CITES, *supra* note 76, art. XVII(1). At the meeting, the proposed amendment must be approved by at least two-thirds of Parties that are present and voting. *Id.* “‘Parties present and voting’ means Parties present and casting an affirmative or negative vote. Parties abstaining from voting shall not be counted among the two-thirds required for adopting an amendment.” *Id.*

285. CITES, *supra* note 76, art. I(a).

purposes” receives the lesser trade restrictions of Appendix II.²⁸⁶ This provision might not be particularly problematic for most de-extinct species, but it could be amended to exclude de-extinct species, which would allow for specimens of an Appendix I de-extinct species bred in captivity to benefit from full Appendix I trade restrictions. A third, related avenue could be to amend Article VII(5) to exclude de-extinct species because Article VII(5) allows the other CITES permit requirements to be bypassed if an exporting country’s Management Authority provides a certificate for an animal specimen that was bred in captivity.²⁸⁷ Amendments to Article VII(4) and Article VII(5) might be problematic, however, because it may be difficult to justify why a de-extinct species should receive more protection than any other endangered or threatened species.²⁸⁸ These considerations are largely academic, however, because the text of the convention almost certainly will not be amended for de-extinct species; therefore, it will be necessary to modify CITES to address de-extinction in other ways.

2. *Revising Existing Resolutions*

While it would be unlikely that the text of CITES could be amended for de-extinction, it would be less difficult to cover de-extinct species through a CITES resolution,²⁸⁹ by either revising an existing resolution (or resolutions) or by proposing and approving a new resolution.²⁹⁰ The CITES Parties may “where appropriate, make recommendations for improving the effectiveness of the present Convention,”²⁹¹ and these recommendations may take the form of a resolution or a decision.²⁹² Between the two forms, a resolution related to de-

286. *Id.* art. VII(4).

287. *Id.* art. VII(5).

288. The arguments on either side likely will remain academic because an amendment to the text of CITES realistically will not happen. Another amendment could be to alter Article II to include de-extinct species in the types of species that are protected by Appendices I, II, and III. Article II defines what species may be listed in the Appendices in fairly general terms, however, and the types of species that may be protected by CITES are explained in more detail in resolutions (especially Resolution 9.24). As such, de-extinct species probably could be protected and regulated more appropriately through resolutions.

289. The CITES Parties revise resolutions quite often (especially compared to how often the convention’s text has been revised). Out of the 89 CITES resolutions that are currently in effect, 61 have been revised at least once. *Resolutions of the Conference of the Parties in Effect after the 16th Meeting*, CITES, <https://cites.org/eng/res/index.php> (last visited Feb. 6, 2016). Resolution 9.24 is no exception—it has been revised numerous times, including at the 12th, 13th, 14th, 15th, and 16th Conferences of the Parties. These Conferences took place in 2002, 2004, 2007, 2010, and 2013, respectively. *Conference of the Parties*, CITES, <https://www.cites.org/eng/cop/index.php> (last visited Feb. 6, 2016).

290. The Parties normally must decide on a draft resolution or decision by consensus, but if they cannot reach consensus, the Parties may vote on its adoption. CITES, *Rules of Procedure of the Conference of the Parties (as amended at the 16th meeting, Bangkok, 2013)*, at rule 21, <https://cites.org/sites/default/files/eng/cop/E16-Rules.pdf>. Similar to an amendment to the treaty’s text, if a vote is necessary, the draft resolution must be approved by a two-thirds majority of those Representatives that are present and voting. *Id.* rule 26. The procedural voting rules are specified in Rules 24–26 of the Rules of Procedure.

291. CITES, *supra* note 76, art. XI(3).

292. *CITES Resolutions*, *supra* note 156.

extinct species is probably preferable because resolutions are more permanent than decisions and may last for many years.²⁹³

A leading candidate for revision is Resolution 9.24 and its annexes, which address the criteria to amend Appendices I and II.²⁹⁴ Resolution 9.24 contains the criteria for listing species in the CITES Appendices—the only way for a species to receive the protections of the convention.²⁹⁵ Annex 1 of the resolution could be revised to include additional criteria upon which a de-extinct species could qualify for listing in Appendix I, and Annex 2 a and Annex 2 b could be revised to include other criteria upon which de-extinct species may be listed in Appendix II. A shortcoming of this approach is that de-extinct species probably could qualify based upon some of the existing criteria, so adding other criteria might make the resolution unnecessarily more complex.

An alternative, and simpler, option is to revise either the body of Resolution 9.24 or some of its annexes to state that the provisions of the resolution include (or do not exclude) de-extinct species. Another possibility would be to revise the definition and explanation of “species” in Resolution 9.24. A clause could be added to the end of the “species” section to clarify that de-extinct species are included (or not excluded) or to note that “species” includes “*any currently living species, subspecies, or geographically separate population that was previously extinct.*”²⁹⁶

Resolution 10.16 is another candidate for a de-extinction revision. As written, it gives an extensive definition and explanation of the phrase “bred in captivity,”²⁹⁷ which could have significant implications for de-extinct species because Article VII(4) and Article VII(5) provide weaker trade controls for specimens that were bred in captivity.²⁹⁸ If the goal is to protect de-extinct species by giving them the best chance of being listed in a CITES Appendix, then Resolution 10.16 could be revised to exclude de-extinct species. This could be accomplished with a revision similar to the suggested revision to the definition of “species” in Resolution 9.24; for purposes of Resolution 10.16, a clause could be added to the following effect: *regardless of the method by which a specimen was developed, any specimen of a currently living species, subspecies, or geographically separate population that was previously extinct*

293. *Id.* Around 90 resolutions are currently in effect, and the Parties have adopted over 270 since 1976. *Id.* The oldest resolution still in effect appears to have been adopted at the Second Conference of the Parties in 1979. *Conference of the Parties*, CITES, <https://cites.org/eng/disc/cop.php> (last visited Feb. 6, 2016); *Resolutions of the Conference of the Parties in Effect after the 16th Meeting*, *supra* note 289. A draft resolution should be submitted at least 150 days before the meeting of the Conference of the Parties at which the draft resolution is to be considered. CITES, Resolution Conf. 4.6 (Rev. CoP16), Submission of Draft Resolutions and Other Documents for Meetings of the Conference of the Parties, ¶ (a) (1983).

294. CITES Res. 9.24, *supra* note 97.

295. *Id.*

296. *See id.* annex 5.

297. CITES Res. 10.16, *supra* note 142.

298. *See* CITES, *supra* note 76, art. VII(4)–(5).

is excluded from the definition of “bred in captivity.” By excluding specimens of a de-extinct species, such specimens would not be considered “bred in captivity,” and Article VII(4) and Article VII(5) thus would not necessarily lead to lesser protections for certain specimens of de-extinct species.²⁹⁹

3. *Proposing a New Resolution*

A more streamlined approach would be to propose a new resolution that focuses on de-extinct species and incorporates some or all of the above-suggested revisions. CITES resolutions usually are somewhat narrow in scope,³⁰⁰ so conceivably, a resolution could address only de-extinct species. The resolution should clarify that de-extinct species are eligible for listing and protection under CITES, and de-extinct species could be defined as *a currently living species, subspecies, or geographically separate population that was previously extinct*, which would harmonize well with the basic definition of “species” that is used for CITES purposes.³⁰¹ The resolution also could provide that de-extinct species should be considered for listing in Appendix I or II in accordance with the criteria provided in Resolution 9.24 (and/or in accordance with other listing criteria that are specific to de-extinct species). In addition, it could state explicitly that Parties may propose that de-extinct species be listed in Appendix III, when appropriate. The de-extinct species resolution also could provide that Article VII(4) and Article VII(5) do not apply to de-extinct species and/or that de-extinct species should not be considered “bred in captivity” as that phrase is defined in Resolution 10.16. Finally, the resolution should confirm that de-extinct species are entitled to the full extent of all protections given to other CITES-listed species and should be treated as other CITES-listed species, except as otherwise provided by the de-extinct species resolution.

B. The CMS, the CBD, and the Cartagena Protocol: An Expected and Reasonable Lack of De-extinction Revisions

Unlike CITES, fewer changes should be made to the CMS, the CBD, and the Cartagena Protocol to address de-extinction. As a framework convention, not many meaningful or appropriate amendments could or should be made to the text of the CMS to ensure that it is directly applicable to de-extinct species. Much like CITES, the CMS could be amended to confirm that it applies to de-extinct species, but such an amendment is unlikely and probably unnecessary.

299. Once more is known about how de-extinction and reintroduction may unfold, Resolution 10.16 might need to be revised again to impose some sort of time limit (perhaps based on population numbers or number of generations since reintroduction) on the exclusion for de-extinct species to allow for de-extinct species that are successfully reestablished to be treated like other CITES species and be considered bred in captivity under certain circumstances.

300. For example, some of the resolutions address topics such as “Conservation of and trade in great apes,” “Bushmeat,” “Trade in elephant specimens,” and “Conservation of and trade in bears.” *Resolutions of the Conference of the Parties in Effect after the 16th Meeting*, *supra* note 289.

301. See CITES, *supra* note 76, art. I(a); CITES Res. 9.24, *supra* note 97.

The CMS applies to migratory species, and to the extent that de-extinct species qualify as migratory, they will be covered under the CMS umbrella. Any significant de-extinction revisions to the CMS should occur in the context of a specific agreement or memorandum of understanding. For migratory de-extinct species to receive any tailored protection under the CMS, Range States will need to enter into an agreement or memorandum under the auspices of the CMS to conserve and manage a particular de-extinct species. The specific provisions within any such agreement would dictate the level of protection and regulation the CMS could provide for a migratory de-extinct species.

Perhaps to an even greater extent than the CMS, de-extinction amendments or changes should not (and realistically could not) be made to the CBD. As explained above, the general conservation principles contained within the CBD could apply, as written, to de-extinct species because de-extinct species would be part of the world's biological diversity. The CBD's provisions do not focus on particular species though, and it would seem somewhat inappropriate to propose a revision to allow for the CBD to focus specifically on de-extinct species.

It would be useful, however, for the CBD Parties to issue a decision related to de-extinct species. The CBD decisions are more focused than the text of the treaty, and this could be an acceptable means by which the CBD could address de-extinction. For instance, in 2012, the CBD Parties adopted Decision XI/28, which focuses on invasive alien species.³⁰² The Parties could adopt a similar decision relating to de-extinct species. Such a resolution could include information about the ways in which the CBD Parties should protect de-extinct species and encourage the Parties to adopt certain regulatory measures to control de-extinct species generally and as potential invasive alien species.³⁰³ In this way, the necessarily broad provisions of the CBD's text would remain in place, and the convention could address de-extinct species through a decision.

In its current form, the Cartagena Protocol probably would apply directly to many de-extinct species because certain de-extinct species could qualify as LMOs. As described above, the Cartagena Protocol's provisions would cover de-extinct species that are resurrected through some form of biotechnology, such as cloning or genetic engineering, but would not cover those de-extinct species that are born as a result of selective mating techniques. Because the Cartagena Protocol already could cover many de-extinct species, significant revisions are probably not necessary.

One might propose that the Protocol could be amended to clarify that all de-extinct species—even those revived using traditional mating techniques—

302. *COP 11 Decision XI/28: Invasive Alien Species*, *supra* note 196.

303. Some of the considerations made regarding invasive alien species may be appropriate considerations for de-extinct species, as de-extinct species could be considered invasive alien species if they have negative effects on the surrounding biodiversity and the environment into which they are introduced. "At a general level, it has been suggested that GMOs released into the environment may pose similar types of risks to those presented by invasive alien species." MACKENZIE ET AL., *supra* note 228, at 10.

would be covered by the Protocol, but distinguishing between de-extinct species born out of strategic mating and other species born out of strategic mating might not be a meaningful distinction and could be a difficult or controversial distinction to make. The Cartagena Protocol focuses on LMOs that result from the use of biotechnology, and the Protocol is probably not the appropriate forum in which all de-extinct species should be addressed. Additionally, some de-extinct species could be revived through a combination of techniques, including some form of biotechnology, and already would fall within the Protocol's purview. An alternative to revising the Protocol itself is to create a supplementary protocol to address issues related to de-extinct species. Overall, though, the Cartagena Protocol probably should remain in its current form, at least as it relates to de-extinct species.

*C. Intellectual Property Regimes: De-extinction Clarifications
Needed Nationally but Not Internationally*

For many convincing (and perhaps obvious) reasons, the intellectual property treaties discussed above should not be amended to address de-extinct species. These are not environmental treaties, and they do not address the protection of biodiversity or the environment; they focus on intellectual property. In addition, these particular intellectual property treaties do not provide many substantive regulations about what is actually patentable; instead, they mostly address broader procedural issues regarding how to obtain patents in different countries. Accordingly, it would be absurd to amend them to focus narrowly on de-extinct species. What will be necessary and appropriate, however, is for countries to decide to what extent, if at all, de-extinct species should be protected as intellectual property and to determine whether de-extinct species are patentable as living organisms under domestic laws. As patent law varies from country to country, so too will the patentability of de-extinct species.

Assuming for argument's sake that enough countries agree that de-extinct species should be patentable and that there is a need for an international intellectual property agreement on de-extinct species, then potentially a de-extinct species patent treaty could be created. Perhaps something similar to the UPOV Convention could be produced for "new varieties" of animal species (de-extinct species). The UPOV Convention's provisions may serve as a useful model for any potential de-extinct species patent treaty. At least for now though, given the current state of disagreement and uncertainty about whether living organisms should be patentable, a de-extinct species patent treaty seems unlikely. The variation among nations regarding the patentability of living organisms is substantial,³⁰⁴ and it will be important to consider whether and how de-extinct species might be "protected" as intellectual property differently around the world.

304. See, e.g., *supra* note 230.

D. A De-extinction Treaty: A More Comprehensive Approach to Protecting and Regulating De-Extinct Species

Although it could be even more time-consuming, labor intensive, and controversial (and perhaps less feasible) than the above-suggested de-extinction modifications to existing treaties, another way to provide more comprehensive protection and regulation of de-extinct species would be to create an international treaty or agreement that focuses exclusively or primarily on de-extinct species. It is beyond the scope of this Article to address exactly what such a de-extinction treaty might look like, but a de-extinction treaty could borrow ideas from existing treaties, especially the international environmental treaties analyzed in this Article. Such a treaty could apply to all de-extinct species (rather than just those that are vulnerable to international trade, that are migratory, or that are revived using certain techniques). A de-extinction treaty would need to strike an appropriate balance between *protecting* de-extinct species and *regulating* de-extinct species to protect the environment, biodiversity, and humans. If necessary, such a treaty could address some of the intellectual property issues associated with de-extinct species. A de-extinction treaty also could explain how to treat and regulate de-extinct species if their populations ever became large and stable enough that they no longer needed to be covered under existing international treaties. Concluding a de-extinction treaty is not something that could or should happen immediately, but if scientists are able to successfully resurrect and reintroduce de-extinct species one day, a de-extinction treaty could provide the needed flexibility to address the unusual and challenging issues that might arise with de-extinct species.

CONCLUSION

As de-extinction efforts move closer to success, the international community should consider the global legal implications of de-extinction and use a precautionary approach to determine how to protect and regulate de-extinct species. Even if the precautionary principle is not “invoked” or applied explicitly in the context of specific international treaties, the precautionary principle’s underlying concept of early action should be applied to address the multitude of issues that will arise with de-extinct species. De-extinct species should be protected early enough to ensure that they do not become extinct again, and this can be achieved—at least in part—through anticipatory changes to the international legal frameworks that protect other species. There also need to be international regulations in place before de-extinct species are introduced into the environment to ensure that de-extinct species do not, like Frankenstein’s monster, cause unnecessary harm to their surroundings.

Protection and control of de-extinct species may be achieved by amending existing international treaties and agreements, amending or proposing new resolutions or similar documents to those treaties, or creating a new treaty or agreement that focuses on how to safeguard and regulate de-extinct species. The most effective approach probably will involve a combination of these

options. Initially, it may be easier to propose new resolutions to existing treaties, but in the long run, it may be necessary to create a new treaty or agreement that focuses primarily or exclusively on de-extinct species. If nations are unwilling to make major changes right away because the concept of de-extinction is still in its infancy, then at the very least, they should start the discourse on the topic now. The future of de-extinction may be unclear, but one thing is certain—acting too early is better than acting too late.