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De-extinction and the Community of Being

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Coming to terms with extinction

Given how deeply it colors our ways of thinking about conservation and the role of humans in nature, we are apt to forget that extinction has entered modern consciousness only recently. Only in the last two centuries has science begun to critically study life’s origins, development, and diversification.¹ Only in the last several generations have we calibrated life’s five ancient extinction events and speculated on their cause-and-effect.² And only in recent decades have we come to appreciate the still-unfolding fate of life’s diversity under the increasing influence of humanity.³

The story of extinction changes as the monumental, multi-generational process of interdisciplinary synthesis and imagination continues. Geology, paleontology, taxonomy, biogeography, and evolutionary biology have allowed us to comprehend the deep temporal and broad spatial dynamics of the extinction story. Archaeology, cultural anthropology, and environmental and economic history have illuminated the role of humans in altering the trajectory of species, landscapes, and ecosystems. Ecology, genetics, population biology, and conservation biology have revealed the more recent patterns in life’s vulnerability and resilience. As a *phenomenon*, extinction is as old as life itself; but as a *story* shaping our consciousness, our values, and our intentions, it is still new.

And it is uncomfortable. We humans have a hard time coming to terms with our awareness of extinction. To hear the story of our own complicity in life’s diminishment is not a task for the timid or the proud. It is so much easier, on the one hand, to avert one’s eyes, avoid the existential crisis, and skip the soul-searching; or, on the other, to see our human dominance as the inevitable and welcome end-result of the long story.

For those who do accept the ethical challenge, the task is unforgiving. Human-caused extinction is not a feel-good topic. The loss of biodiversity does not lend itself to agreeable dinner conversation or commencement oratory. For conservation scientists and educators trying to communicate their concern, it makes for hard story-telling. People grow weary of the hard news, especially alongside other concurrent narratives of global, postmodern gloom. We prefer the comfort of positive tales, hopeful examples, and affirmative acts. In fact we yearn for them, mightily.

The prospect of overcoming extinction—of seeking to reverse what has until now been irreversible—both expresses and answers to that yearning. Under the banner of de-extinction, the new techniques of genomic reconstitution provide a possible counter-narrative. Instead of incessant lamentation, we can thrill to the reclaiming of lost life. Instead of dwelling on a tragic past of human-induced ecological wounds, we can look forward to a future of bioengineered recovery. De-extinction technologies can disrupt the dour old conservation movement as easily as Uber has disrupted the taxi industry. It can dispel the very reality of extinction. It can change the story.

Even the dowdiest conservationist can understand the appeal. They may even share it. The appeal is powerful. The prospect of de-extinction taps into deep layers of human myth and meaning, involving ancient themes of life and death, light and dark, creation and chaos, loss and resurrection, agency and fate, guilt and redemption. The optimism behind it has, after all, served our species well. And so the great irony: the prospect of de-extinction appeals to our pragmatic, Promethean cleverness⁴—that part of our humanity that allowed us to rise (or fall) to ecological dominance and gave us the power

to drive other species to extinction in the first place. How we process that irony reveals what lessons we humans have learned in becoming not just the subject, but a self-conscious *agent*, of evolution.

The historical response to anthropogenic extinction: a brief review

Once paleontologists established the fact of past extinction events, and once naturalists focused on the human role in recent and contemporary extinctions, the moral response followed. Alfred Russel Wallace (1863) lamented “the extinction of the numerous forms of life which the progress of cultivation invariably entails” and instructed his fellow naturalists to amplify their efforts to document life’s diversity:

If this is not done, future ages will certainly look back upon us as a people so immersed in the pursuit of wealth as to be blind to higher considerations. They will charge us with having culpably allowed the destruction of some of those records of Creation which we had it in our power to preserve; and while professing to regard every living thing as the direct handiwork and best evidence of a Creator, yet, with a strange inconsistency, seeing many of them perish irrecoverably from the face of the earth, uncared for and unknown.⁵

Over the next half-century the incidence of documented extinctions increased—e.g., of the great auk (1852), Labrador duck (1878), and quagga (1883). Other well-known species such as the American bison and passenger pigeon faced extraordinary, rapid declines. Early conservationists began to make the case for valuing other lifeforms and for taking action to prevent human-caused extinction. “All nature,” George Perkins Marsh wrote in 1864, “is linked together by invisible bonds, and every organic creature, however low, however feeble, however dependent, is necessary to the well-being of some other among the myriad forms of life with which the Creator has peopled the earth.”⁶ Theodore Roosevelt regarded it as “vandalism wantonly to destroy or to permit the destruction of what is beautiful in nature, whether it be a cliff, a forest, or a species of mammal or bird.”⁷ Zoologist and activist William Temple Hornaday (in one of his more restrained moments) held that “The wild things of this earth are not ours to do with as we please. They have been given to us *in trust*, and we must account for them to the generation which will come after us and audit our accounts.”⁸ The decline and loss of wild species became an important force behind the American conservation movement as it developed in the early 20th century. Scientific concern, policy actions, and moral fervor intensified further with the passing of Martha, the last passenger pigeon, in the Cincinnati Zoo on September 1, 2014. The well-publicized extinction event gave the campaign for wildlife protection new urgency, leading to such landmark steps as the signing of the U.S./Canada Migratory Bird Treaty (1916).⁹

For all the growing fervor, there was as yet no generally developed science or technique for sustaining or restoring viable populations of wild animals *in situ*. Wildlife conservation and management, such as they were circa 1930, involved the passage of more restrictive game laws and regulations, persecution of predatory species, artificial rearing of some hunted species on game farms, and establishment of occasional game refuges (with the assumption that national parks and other protected areas would suffice to maintain wildlife). In a 1930 address, Aldo Leopold noted that these steps, “which served to string out the remnants of the virgin game supply... seem to have reached the limit of their effectiveness. Sometimes new must be done.”¹⁰

That “something new” required nothing less than a paradigm shift and the creation of a new professional field. Wildlife management first arose in the 1930s, based on the fundamental insight that the status of any species, in any place, at any time, is a function and expression of its ecological relationships. In an early formulation of this novel approach, Leopold stated, “the one and only thing we can do to raise a crop of game is to make the environment more favorable. This... is the fundamental truth which the conservation movement must learn if it is to attain its objective.”¹¹

Over the next decade, as Leopold and his contemporaries labored to apply emerging ecological concepts to the conservation cause, the scope of the new field widened to embrace the full diversity of

wildlife, including rare and threatened species: “No species can persist whose environment is no longer habitable. The next move is to examine each threatened species, to analyze its requirements for reproduction and survival, to build out of this knowledge a technique of conservation, and to bring this technique to the attention of landowners who can apply it.”¹² As the paradigm began to shift, conservation began to redefine itself, to lift its eyes beyond the value and fate of particular species to the functional health of entire communities, landscapes, and ecosystems. By 1939 Leopold would conclude: “The emergence of ecology has placed the economic biologist in a peculiar dilemma: with one hand he points out the accumulated findings of his search for utility, or lack of utility, in this or that species; with the other he lifts the veil from a biota so complex, so conditioned by interwoven cooperations and competitions, that no man can say where utility begins or ends.”¹³

A generation of conservationists, tempered by the experience of deforestation, depleted wildlife, and epic soil erosion, had come to realize that the vision for conservation had to be as complex as the community of life itself—and that community included people. For the sake of this essay, let us call this the *relational* concept of species extinction and conservation. As ethicist Ronald Sandler has emphasized, “what is important about species is not just that they exist but that their existence is in context, as part of relationships, performing specific functions.”¹⁴

In the decades since, conservation has struggled to reorient itself in keeping with this concept, even while warding off the same old exploitative threats *and* addressing intensified global environmental dilemmas. The Endangered Species Act and other legal mechanisms absorbed the science and codified the protocols for meeting the biological needs of species. Landscape ecology, conservation biology, agroecology, ecosystem management, community-based conservation, ecosystem services, and other fields and approaches emerged to cut across disciplines, jurisdictional boundaries, and value systems.¹⁵ The “land ethic” that Leopold drew out of his experience has, by one reading, been overwhelmed by the post-war “great acceleration” into the Anthropocene. In an alternative sense, however, the land ethic continues to evolve and has provided the rootstock for an increasingly urgent and unifying earth ethic.¹⁶ More than ever, conservation is, and will always be, all about *relationships* that promote social and ecological resilience at multiple scales of time and space.

The complexity of modern extinction

What does all this mean in terms of the prospects for de-extinction? Whatever else it entails, it may lead us to appreciate the complexity of modern extinction as a phenomenon. The stark reality of extinction leads us to think of it in simple terms: it’s the end of a biological line. But extinction in the modern age—and, in general, the status or fate of any species—is hardly simple. Conservation biologists, summarizing the primary threats to biodiversity, recognize several “horsemen of the ecological apocalypse”: over-exploitation, habitat destruction (including pollution), introduced species, disease and other interspecific impacts. In recent years, they have tended to add a fifth—climate change—and to emphasize the ominous synergies among them.¹⁷ Extinction is not so much the line at the end of a straight path as the culminating moment in a complicated vortex.

Moreover, conservation biologists have increasingly come to recognize and emphasize the obvious: that each of these threats has a social and cultural dimension.¹⁸ The status of a species reflects not only a suite of biological vulnerabilities but a set of ever-shifting, ever-evolving ecological and social relationships. The presence or absence of a species in a landscape is as much an expression of a community’s history, values, and priorities as the presence or absence of a school, or hospital, or church, or grocery store. The persistence, demise, or recovery of a species is a manifestation of a human community’s collective knowledge, ethic, economy, policies, practices, and ecological condition.

Extinction, then, does not merely mark the end of a genetic line and the blinking out of a population or a last individual. It is the final stage in the dimming and fraying of a socio-ecological reality. As such, global extinctions and local extirpations are also biological barometers. Like abnormal soil erosion or water pollution or anthropogenic climate change, species extinctions and extirpations are

outward indicators of troublesome trends in our landscape relationships and in our ways of living with each other and with other species, within entire ecosystems.

The first five great extinctions, of course, occurred in the absence of humans. We are driving the sixth great extinction. Henceforth, because of our now pervasive influence on global conditions, any extinction will involve some degree of human implication (and hence ethical consideration). Extinction is a natural process that human agency has exacerbated and accelerated over the millennia. As the human role within natural communities has intensified in recent centuries, and especially in the last few decades, extinction has become more and more a *social* process.

Extinction, however, is just one (albeit ultimate) expression of any given species' status. Species *survival* is a function of continuity and connection within human and natural communities. Species *abundance* is an expression of biological opportunity and socio-ecological context. Species *loss* is the result of links that have inadvertently eroded—or that have been purposefully broken—in the land (and Earth) community. Species *recovery* is the result of links reestablished, space reclaimed, human values and priorities shifting, and potentials realized in a changed and ever-changing environment. The passenger pigeon was lost because its particular life history, behavior, and ecological requirements could not adapt in the face of colonization, relentless market demand, new technologies (especially the railroad, telegraph, and firearms), and the lack of any ethical restraint among its exploiters.¹⁹

The history of modern wildlife conservation may be read as the effort to recognize and respond to this ecological and social complexity: to take into account the scales of time and space, rapidly changing environmental conditions, and diverse social and economic circumstances that define the context of any species. Let us remember, as well, that *wildlife* conservation is but one part of conservation's much broader portfolio. While we often focus on the fauna—and usually the charismatic fauna—conservation is also concerned with the status and resilience of soils, fresh waters, watersheds, plant communities, whole landscapes, and the oceans; with the stewardship of farms, forests, rangelands, and fisheries; with the restoration of ecosystems and cultural connections to lands and waters; with food systems and human health, vibrant cities and local economies, justice and climate and the claims of future generations. The status of a species, and the efficacy of any human intervention in the trajectory of that species, is embedded within a wide field of conservation needs.

De-extinction, complexity, and reductionism

The viability and utility of de-extinction as a conservation technique should be considered within this complex context. The effort to resurrect extinct species now provides a new and unprecedented twist in the great narrative of life on Earth, and of conservation's efforts to sustain biodiversity and resilient ecosystems while meeting human needs. As Stanley Temple has noted, "If extinction is not forever, a lot changes."²⁰ We might add that it potentially changes things in terms not only of biological organisms and systems, but of conservation's aims, priorities, and approaches.

Others have defined the array of pros and cons of de-extinction as a possible innovation. And debates have ensued over the issues and concerns that come with the technical advances: that the revival and release of de-extincted species could interfere ecologically in unpredictable ways with existing wildlife populations; that they may pose other potential biological risks (i.e., as pests, disease vectors, or invasive species); that de-extinction efforts will divert attention and resources from efforts to conserving extant biodiversity (i.e., that it presents a moral hazard); that individual animals produced through unproven techniques may experience undue suffering; that the legal status of such potential creatures (especially as intellectual property) is unclear and problematic; that extinct species in fact have a critical continuing role to play as conveyors of the value of "collective self-restraint... human limits... [and] earthly modesty."²¹

Of all de-extinction's potential implications, the one I find most revealing involves the implicit species concept that defines much of the current interest. In contrast to the embedded, relational species concept toward which conservation has fitfully advanced, albeit belatedly, over its history, de-extinction is prone to regard species the old-fashioned way: as a malleable part—in this case a malleable *genome*—

isolated in time and space, detached from its ecological milieu and its ethological expression, with little consideration given to its human social context. Whereas the relational view of species has required an ethical response to conservation challenges, this *reductionist* concept of the species, with its focus on the genome, focuses first and foremost on providing a technological fix for the modern problem of anthropogenic extinction.

This is problematic on several levels. The supposition is that resurrecting (or perpetuating) a species is first and foremost a matter of manipulating gene sequences and engineering individual organisms, not of reconstituting and sustaining community relationships—among humans, within ecosystems, and between humans and nature—that can support healthy populations capable of perpetuating themselves within their changing places. However captivated we may be by the technological achievement, it begs the question: What is the *conservation* value of a de-extincted species if the landscape is unable to receive or support the revived populations?²²

At least at this early point in its career, de-extinction has displayed a narrowly reductionist and technocratic approach to the fate of species. Decades of hands-on experience in diverse species re-introductions has taught conservationists a basic lesson: that reintroduction does not take place in a social or ecological vacuum. No species exists, or can thrive, or can be restored, apart from the intricate reality of its behavior patterns, population dynamics, ecological relationships, and human social contexts (not to mention its project budget). Swedish environmental historian Dolly Jørgensen has elaborated on this point: “If you look at cases where predators have tried to be reintroduced following periods of local extinction—like the lynx in Scotland and wolves in Europe—what you see is that it’s a very contested space.”²³

Even relatively successful, *uncontested* reintroduction efforts involve years of detailed research, planning, and preparation, careful attention to communication and social realities, and a deliberative process of adaptive management. When a herd of twenty bison returned to the Nachusa grasslands in Illinois in the fall of 2014—the first to roam the area since the 1830s—they did not do so by swimming themselves across the Mississippi River. They came by trailer from Iowa and, as a *Chicago Tribune* editorial noted, “settled into prairies that Nachusa’s volunteers had spent 450,000 hours preparing.”²⁴ Seventy years of devoted work have brought the whooping crane back from the brink of extinction, but it has taken a conservation village to do it: generations of devoted field biologists, aviculturists, ethologists, geneticists, educators, policy-makers, administrators, volunteers, funders, and citizen scientists. And still, between 2011 and 2016, one in five whooping cranes in the reintroduced eastern population whose cause of death could be determined—more than twenty individuals—were illegally shot.²⁵

In short, reconstituting a genome is not the same as conserving a species or a place. Undoubtedly, recovering the pieces of an extinct genetic line and fashioning a viable organism from them are daunting technical tasks. Yet, however difficult, those tasks are so much easier than the careful, demanding, day-to-day, person-to-person, person-to-place, life-long practice of conservation—not merely the weaving together of bits of genetic material in a laboratory, but of healthy relationships on the landscape.

An argument can be made that de-extincting a species is in some sense a human effort, and a community effort, to right a human-caused wrong. In the case, for example, of the passenger pigeon, it certainly draws upon the historic efforts of nineteenth-century naturalists who devoted themselves to collecting specimens of the doomed bird and techniques developed by cadres of modern synthetic biologists. But this points to a more fundamental flaw in the reductionist concept and definition of a species. As conservation biologist (and pigeon expert) David Blockstein has noted, “the ecological niche of the passenger pigeon is as gone as the bird. ... Just as technology cannot bring back the dead, genetic technology cannot bring back the extinct. ... Certainly nobody knows what the behavior of such birds [i.e., products of de-extinction] would be—but it would not exhibit the unique behaviors of the Passenger Pigeon and it would not be a Passenger Pigeon.”²⁶

This is the difficult, final truth of extinction that we have such a hard time accepting: technology cannot, and can never, recreate a lost species, because a species is more than its genome; it is the expression and evolution of the genome, through a vital population, interacting with and within a unique

environment, over a unique period of time. We may be able to fabricate a chimeric genome, and there may be value in that work, but we cannot “bring back” a species. The draft *Guiding Principles on De-extinction for Conservation Benefit* of the IUCN (World Conservation Union) Species Survival Commission makes this point more precisely: “Epigenetic effects, the influence of the rearing environment, the absence of appropriate conspecific learning opportunities, and other factors (e.g. microbiome) will result in the creation of proxies that differ in unknown and unpredictable ways from the extinct form, even as clones of the original.”²⁷

In the IUCN document’s words, “technology cannot fully restore once extinct species due to inevitable genetic, physiological, behavioural, and other variations.”²⁸ Extinction, in other words, *is* indeed forever. And de-extinction, it follows, is a literal impossibility. The products of de-extinction can never be more than artificial proxies. The *thing* that we are purporting to de-extinct has ceased to exist, and can never exist again because the spatial and temporal context of that *thing*, and the set of relationships that defined it, no longer exist. In reality, de-extinction techniques would create new life forms, albeit out of extant bits and scraps of older genetic material. Should they come into being, we may certainly wonder at them as products of our human genius for invention. We may value them as providers of lost ecosystem services; as expressions, after a fashion, of our regret and longing; and even as objects of beauty and rarity in their own right. But in regarding them as somehow overcoming extinction, we admit the difficulty we have in facing the finality of extinction.

Of melomys and megafauna

In June 2016, Australian scientists reported that the only known population of the Bramble Cay melomys (*Melomys rubicola*), or mosaic-tailed rat, had blinked out. The melomys, an unassuming rodent found only on a tiny coral island at Australia’s northernmost tip, was last seen in 2009. In the report’s stark language: “The key factor responsible for the extirpation of this population was almost certainly ocean inundation of the low-lying cay, very likely on multiple occasions, during the last decade, causing dramatic habitat loss and perhaps also direct mortality of individuals.” Analysis of sea-level rise, increased frequency and intensity of weather events, and “extreme high water levels and damaging storm surges” in the region led the biologists to identify “human-induced climate change [as] the root cause of the loss of the Bramble Cay melomys.” Although there is hope that the species, or a closely related one, might be found across the Torres Strait in New Guinea, the report’s findings made headlines around the world. As the authors noted, “this probably represents the first recorded mammalian extinction due to anthropogenic climate change.”²⁹

In such reports it is customary to offer recommendations. In the case of the melomys, the recommendations could hardly be less inspiring. The scientists call for amending the status of the species under Queensland and Australia’s statutes and on the IUCN Red List. They recommend field surveys in New Guinea, and collection of DNA data from any specimens found there. They note the need to assess the threat to important turtle and seabird rookeries also found on Bramble Cay. There is no call to de-extinct the Bramble Cay melomys. As more and more species face the intensifying storms of climate change and the continuing pressures from the old “horsemen of the ecological apocalypse,” it is hard to imagine how applications of de-extinction technology will be able keep up—how, even with the best of intentions, they can provide a meaningful response to the rising waves of extinction.

There is an even less encouraging conclusion, guaranteed, alas, to confirm the stereotype of the dour conservationist. De-extinction, however new and attention-grabbing the technique, may simply perpetuate an ancient human flaw. It is liable to become just the latest example of human technological capacity outstripping its ethical application. Reflecting upon the meaning of the passenger pigeon’s annihilation, Aldo Leopold observed, “for one species to mourn the death of another is a new thing under the sun.”³⁰ It *was* a new thing. Other species were and are blissfully unconscious of extinction. And as noted above, for humans with modern science at their disposal it presented an unprecedented moral challenge.

For Leopold and others, the loss of the pigeon and knowledge of other modern extinctions served as a call for critical examination of our community values. “This new knowledge should have given us, by this time, a sense of kinship with fellow-creatures; a wish to live and let live; a sense of wonder over the magnitude and duration of the biotic enterprise.”³¹ Our era of accelerated anthropogenic threats to biological diversity prompts us to seek not merely technological, but ethical, innovation. Those are not, need not be, and cannot be, exclusive categories. But the latter is always so much more difficult and complicated than the former; we always seem to find it so much easier to change the world around us (and the *things* within it) than to change ourselves.

Yet, guidance comes from history and from an array of cultural traditions.

I introduced this discussion with the premise that awareness of extinction is a recent phenomenon and that we have yet to come to terms with that awareness. However, the premise does not hold for all cultures in all times and places. In Native American experience, to cite one important exception, we may find echoes of the loss of the Pleistocene megafauna. Kiowa poet and writer N. Scott Momaday has voiced this view, describing the emergence of Clovis culture and the effect of Paleoindian hunting on the development of Native American ethics. The passage is worth quoting in full:

This ancient drama of the hunt is enacted again and again in the landscape. The man is preeminently a predator, the most dangerous of all. He hunts in order to survive; his every existence is simply, squarely established upon that basis. But he hunts also because he can, because he has the means; he has the ultimate weapon of his age, and his prey is plentiful. His relationship to the land has not yet become a moral equation.

But in time he will come to understand that there is an intimate, vital link between the earth and himself, a link that implies an intricate network of rights and responsibilities. In some unimagined future he will understand that he has the ability to devastate and perhaps destroy his environment. That moment will be one of extreme crisis in his evolution.

The weapon is deadly and efficient. The hunter has taken great care in its manufacture, especially in the shaping of the flint point, which is an extraordinary thing. A larger flake has been removed from each face, a groove that extends from the base nearly to the tip. Several hundred pounds of pressure, expertly applied, were required to make these grooves. The hunter, then, is an artisan. His skill, manifest in the manufacture of this artifact, is unsurpassed for its time and purpose. By means of this weapon is the Paleo-Indian hunter eminently able to exploit his environment.

Thousands of years later, about the time that Columbus begins his first voyage to the New World, another man, in the region of the Great Lakes, stands in the forest shade on the edge of a sunlit brake. In a while a deer enters into the pool of light. Silently the 20 man first an arrow to a bow, draws aim, and shoots. The arrow zips across the distance and strikes home. The deer leaps and falls dead.

But this latter-day man, unlike his ancient predecessor, is only incidentally a hunter; he is also a fisherman, a husbandman, even a physician. He fells trees and builds canoes; he grows corn, squash, and beans, and he gathers fruits and nuts; he uses hundreds of species of wild plants for food, medicine, teas, and dyes. Instead of one animal, or two or three, he hunts many, none to extinction as the Paleo-Indian may have done. He has fitted himself far more precisely into the patterns of the wilderness than did his ancient predecessor. He lives on the land; he takes his living from it; but he does not destroy it. This distinction supports the fundamental ethic that we call conservation today. In principle, if not yet in name, this man is a conservationist.

These two hunting sketches are far less important in themselves than is the long distance between them, the whole possibility within the dimension of time. I believe that in that interim, there grew up in the mind of man an idea of land as sacred.³²

Lessons of the Pleistocene remain embedded in the varieties of Native American land ethics, which share, in their diversity, a relational understanding of kinship within and across species boundaries.

Robin Kimmerer also gives voice to this understanding, drawing upon her Anishinaabe tradition: “Ecological restoration is an act of reciprocity and the Earth asks us to turn our gifts to healing the damage we have done. The Earth-shaping prowess that we thoughtlessly use to sicken the land can be used to heal it. It is not just the land that is broken, but our relationship with land. We can be medicine for the Earth, partners in renewal.”³³

The prospect of de-extinction now places difficult questions before us. Given the powerful tools of synthetic biology now in our hands, what does reciprocity entail? How can and should relations be healed or renewed when extinction has severed the living connection? How do we most appropriately honor the extinct? By pursuing their resurrection, or honoring their martyrdom? Does de-extinction represent an ultimate act of selflessness—the application of human ingenuity on behalf of another species—or is it in fact an ultimate act of hubristic selfishness?

In one of the most forceful passages of *Laudato Si*, Pope Francis asks that species be honored for their intrinsic value, not for what we make of them: “It is not enough, however, to think of different species merely as potential ‘resources’ to be exploited, while overlooking the fact that they have value in themselves. Each year sees the disappearance of thousands of plant and animal species which we will never know, which our children will never see, because they have been lost forever. The great majority become extinct for reasons related to human activity. Because of us, thousands of species will no longer give glory to God by their very existence, nor convey their message to us. We have no such right.”³⁴ In this the pope adds the church’s voice to the ongoing elaboration of conservation ethics. In its draft *Guiding Principles on De-extinction*, the IUCN anticipates the next question: “Humans have a moral obligation not to render species extinct, but it is unclear if this extends to a moral obligation to resurrect them.”³⁵

Writing from Buddhist tradition, monk and scholar Tikh Naht Hahn has proposed the concept of *inter-being* to highlight the realization that what we regard as our “separate” selves, and separate things, exist as manifestations of community relationships. “Nothing can exist by itself alone. It has to depend on every other thing. That is called inter-being. To be means to inter-be. The paper inter-is with the sunshine and with the forest. The flower cannot exist by itself alone; it has to inter-be with soil, rain, weeds and insects. There is no being; there is only inter-being.”³⁶ With recent research and description of the human microbiome, we now see in even more literal terms that the boundaries of selfhood are, in one sense, fuzzy; but we might just as well view them as *expansive*.³⁷

So with the boundaries of species-hood. In all these cultural expressions, we are encouraged to see species not merely as raw genetic material that can be reconstituted in new forms, but as unique manifestations to be honored through our evolving relationships. From the ancient disappearance of the Pleistocene megafauna to the advent of extinction in the Anthropocene, humans have defined our humanity in part through our inventive genius, but also through our deepening awareness of creation’s unique and ephemeral manifestations—and of that which we have needlessly lost. We are still becoming human, still coming to appreciate the creatures and places that we share with, and within, the community of being.

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⁵ A. R. Wallace, “On the Physical Geography of the Malay Archipelago,” *Journal of the Royal Geographical Society* 33 (1863): 217-234, at 234.

⁶ G. P. Marsh, *Man and Nature, or Physical Geography as Modified by Human Action* (New York: Charles Scribner, 1865), 109.

⁷ T. Roosevelt, “Our Vanishing Wild Life,” *Outlook* (25 January 1913): 161-162, at 161.

- ⁸ W. T. Hornaday, *Our Vanishing Wild Life: Its Extermination and Preservation* (New York: Charles Scribner's Sons, 1913), 7.
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- ¹³ A Leopold, "A Biotic View of Land," *Journal of Forestry* 37, no. 9 (1939): 727-730, at 727.
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