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ORIGINAL PAPER

The Ethics of De-Extinction

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Abstract "de-extinction" refers to the process of resurrecting extinct species by genetic methods. This science-fiction-sounding idea is in fact already in early processes of scientific implementation. Although this recent "revival of the dead" raises deep ethical questions, the ethics of de-extinction has barely received philosophical treatment. Rather than seeking a verdict for or against de-extinction, this paper attempts an overview and some novel analyses of the main ethical considerations. Five dimensions of the ethics of de-extinction are explored: (a) the possible contribution of de-extinction to promoting ecological values, (b) the deontological argument that we owe de-extinction to species we rendered extinct, (c) the question of "playing God" through de-extinction, (d) the utilitarian perspective, and (e) the role of aesthetic considerations in the ethics of de-extinction. A general feature arising from the paper's discussion is that, due to de-extinction's special character, it repeatedly tests the limits of our ethical notions.

Keywords De-extinction · Environmental ethics · Bioconservation · Biodiversity · Species rights · Respect for life · Genetic engineering · Cloning

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"De-extinction" refers to the process of resurrecting extinct species by genetic methods. The idea first elicited wide attention with Michael Crichton's *Jurassic Park* (1990), and in the intervening years de-extinction has moved from science fiction to tentative scientific implementation. This development is of no small significance. As (prominent geneticist) George Church and Ed Regis write, the first (mildly) successful case marked a turning point in history, since "on that date, all at once, extinction was no longer forever" ([1]: 136). This is surely impregnated with philosophical meanings that demand exploration. This paper will focus on the ethical aspects of de-extinction.

Skepticism about de-extinction has been met by a common attitude of scientific explorers: "That this is even a possibility is reason enough to explore it seriously" [2]. There is, accordingly, good reason to predict that research and implementation of de-extinction will increase significantly in the coming years. Public debate on this new, revolutionary field is bound to ensue. To date, however, the ethics of de-extinction has barely received philosophical treatment.[1] This paper offers an overview and analysis of the main ethical considerations.

Five dimensions of the ethics of de-extinction are explored: the axiological question of promoting ecological values, the deontological question of whether we owe de-extinction to species we rendered extinct, the

[1] Much of the agenda for the philosophical exploration of de-extinction was laid out succinctly by Sherkow and Greely [3]. While concluding work on this paper, Sandler [4] has appeared online; so did Cottrell et al. [5]; see also Gamborg [6].

ethical-existential question of "playing God" through de-extinction, the utilitarian perspective, and the place of aesthetic considerations in the ethics of de-extinction. The topic of de-extinction cuts across a variety of deep ethical issues that exceed our focused analysis; my primary aim is rather to set forth a framework for ethical thinking on de-extinction.

Scientific Précis

A concise summary of state-of-the-art practice should provide an orienting background for the ethical discussion.

There are three plausible methods for resurrecting extinct species. (1) Cloning, or Somatic Cell Nuclear Transfer. A cell nucleus from well-preserved tissue of an individual of the extinct species is inserted into an (enucleated) ovum of a female of a related species. The cell, now carrying (almost precisely) the genome of the extinct species, is induced to replicate and inserted to the female's uterus. If pregnancy is successful, she gives birth to an offspring of the extinct species. (2) Genetic engineering. When well-preserved cell nuclei do not exist but DNA fragments do, the latter—probably from many different specimens—can be sequenced and then spliced into the genome of a closely related species. The new transgenic organism will not belong to the extinct species, but will have many of its traits. Repeated over a few generations, this process can ideally eventuate in an organism very similar to the extinct one. (3) Selective breeding. Turning to the species most closely related to the extinct one, which exhibits part of the extinct species' genetic variation, we select and breed the individuals exhibiting the phenotypes most similar to the extinct species'. This process is repeated, probably with the help of gene insertions, until the progeny resemble the extinct species as much as possible.

The Pyrenean ibex (extinct in 2000) was the first (sub-) species to have been de-extinct in some threshold sense. A live kid, a clone of the last individual, was born alive in 2009. It only lived a few minutes, however, dying from a lung defect. Another cloning-based de-extinction project that is underway involves the gastric-brooding frog. This species, whose female uniquely gestates her fertilized eggs in her stomach, has been extinct since the 1980's. The Lazarus Project team in Australia reportedly created viable cloned embryos. A U.S. team is working on resurrecting the passenger pigeon (extinct in 1914) by genetic engineering the band-tailed pigeon. Russian and Korean teams are working on getting enough DNA from remnants of the wooly mammoth buried in the Siberian permafrost to allow for genetic engineering, using the Asian elephant as surrogate. Finally, a project in South Africa has been trying to revive the extinct quagga by back-breeding zebras. A similar project in Europe attempts since 2008 to revive the aurochs, the ancestor of domestic cattle.

Ecological Axiology

Defying the anthropocentrism that dominated traditional ethical theories, certain environmental philosophies have advocated the inherent worth of nature and all living things, regardless of their instrumental utility as resources for humans. In Aldo Leopold's influential formulation, "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" ([7]: 224–225). Accordingly, the primary ethical argument for de-extinction is its potential contribution to the environment—specifically, to promoting biodiversity.

This argument for de-extinction must surmount two challenges, however. It may be argued that de-extinction lacks positive ecological value either in principle or all things considered. Let us examine these in turn.

The first objection is that de-extinction cannot be ecologically valuable in principle. Before considering the philosophical argument, I shall briefly mention a parallel opposition from biology. It can be argued that extinction is absolutely normal, the necessary mirror phenomenon of speciation (an estimated 99.9% of species have disappeared) ([8]: 3–4); de-extinction is therefore naively wrongheaded. The answer to this is the combination of two facts. The first is that the staggering current rate of extinction strongly suggests that the biological world is experiencing the sixth major extinction event in its history [9]. Up to 50% of species according to one prediction will be lost in the first half of the 21st century [10]. The second is that this historical extinction is predominantly human-triggered, expressing an ever-increasing use of the world's resources by an expanding human population (major processes include habitat destruction, fragmentation, and degradation, pollution, overexploitation of species, introduction of invasive exotic species, and increased spread of disease [11,

12]; in recent decades global warming has increasingly altered species' habitats beyond survival ranges [13]). Extinctions caused by human encroachment do not fit in the natural turnover of species based on the survival of the fittest. "Natural extinction typically occurs with transformation, either of the extinct line or related or competing lines. Artificial extinction is without issue. One opens doors; the other closes them. Humans generate and regenerate nothing; they only dead-end these lines" ([14]: 724). In light of all this, we may suppose that reintroducing species extinct by humanity to enhance biodiversity can be ecologically beneficial.

The philosophical argument against performing de-extinction for nature's sake is the following. If nature has intrinsic value, this value must entail independence (autonomy) from human purpose, activity and interest. Humans cannot restore natural intrinsic value, since all restoration is, *qua* human creation, *artifactual*—the precise antonym of the natural. An artifact's value is instrumental to the human purpose in creating it; it hence, *ipso facto* loses all intrinsic value [15]. Relatedly, Bernard Williams spoke of a "paradox" when "we have to use our power to preserve a sense of what is not in our power" ([16]: 240). One cannot manipulate nature in order to preserve its autonomy; yet only as autonomous is it intrinsically valuable. If correct, this would undermine the ecological value of de-extinction.

In response, we must analyze the sense of autonomy presupposed by this criticism. Since autonomous nature is taken to be conceptually opposed to that of artifact, we shall examine the relevant senses of artifact. Three senses can be extracted from pertinent criticisms.

(1) *Being the result of human involvement*. According to this most rigid criterion, corresponding to the ideal of nature as pure wilderness, even true-to-original restoration undermines natural value. The analogy with works of art, whose causal genesis and history determine their value, is here central. Just as the aesthetic value of forged artwork, even if seemingly indistinguishable from the original, is radically lower due to lack of authenticity, so restored nature has radically lower ecological value due to lack of naturalness [17]. Accordingly, since de-extinction inevitably creates artifacts, its potential contribution to the intrinsic value of nature is essentially undermined. The response to this critique highlights the measure of continuity between humans and nature, deconstructing the sharp dichotomy between them. Imagine for instance that seeds of a certain bush attached to the shoe of a foreign traveler get spread in a new land, integrating in the local flora. Does the human vehicle per se make this species an artifact in its new habitat? Migrating large mammals sometimes spread through their dung new plant species into new ecosystems; is the fact that the human flew in an airplane instead of walking enough to render the newly introduced species unnatural? Or if we clear some hiking trails on a mountain slope, does the slope become an artifact? It has been argued that since humans are part of nature, human intervention is by definition natural too [18]. This is a gross exaggeration, but so is a dichotomy between natural and artifactual. Indeed, at times human restoration is best conceived of as merely removing obstacles for nature to restore itself, hence preserving nature's role as "creator." Consequently, one assumes a threshold below which human involvement is not only tolerable on balance but non-problematic in principle. Recognizing some continuity between "human" and "natural," and assuming that the existing natural variety was not intentionally designed but randomly produced, we may argue that human intervention does not parallel the lack of authenticity in forging someone else's artwork. In such a context, the relationship between our admiration of process and of product is different from the paradigm in art. All these considerations should be weighed in order to determine if, when, and to what extent ecological contributions of de-extinction may be undermined by considerations of authenticity.

(2) *Expressing original human design*. Most blatantly, if scientists design *de novo* an entirely new life form which is then created by methods of synthetic biology, this designing produces an artifact. On the other end of the spectrum is the reintroduction of individual animals to an area from which their species has been extirpated. In this latter case, the charge of substituting nature with an artifact is highly puritan: designing a natural solution is not designing nature. Now de-extinct species would obviously not be products of human imagination. Yet, admittedly, they will not be exact replica of the extinct species either (due to epigenetic factors, different mitochondrial DNA, lack of natural learning from animal group, new gene insertions, and

probably other factors). Here too, case-by-case analysis should determine what level and kind of designing on the above spectrum could be perceived as creating "artifacts." A pertinent general consideration is the vague border between de-extinction and allegedly non-problematic traditional conservation methods (especially back-breeding). Note, moreover, that the very distinction between bioconservation and resurrection is not clear-cut (if for example but a few female individuals remain in captivity, is the species considered extinct? And if we then use cloning to get those females pregnant, have we or have we not performed a *revival*?); hence we cannot automatically pigeonhole de-extinction as "unnatural designing."

(3) *The presence of human intentionality or purpose*. All human action is purposeful; all results of human action are hence infused with human purpose. According to Eric Katz [15], even seemingly natural entities, if humanly contrived, *ipso facto* become artifacts by embodying human purpose. This criterion sets them as ontologically distinct from wild nature. Since *qua* human activity de-extinction expresses human goals, its products will be artifacts devoid of the intrinsic value characterizing autonomous nature. In response we deny that to be invested with human purposeful activity is what makes something into an artifact; it is rather being so invested for the sake of serving a human purpose which does. As Yeuk-Sze Lo rightly argues, "Whether human technology is involved in a nature restoration project is simply irrelevant to whether the purpose behind the project is anthropocentric" ([19]: 253). Accordingly, de-extinction can be executed to serve pure biocentric goals, for example, to mitigate human-caused loss of biodiversity. In such cases, the products of human activity will not be tools for human purposes and therefore not artifacts. Alternatively, we can acknowledge more than one sense of "artifact," and then test each for its compatibility with an attitude of respect for nature. This consideration will point in the same direction: we may call de-extinction products artifacts, but as long as de-extinction is not a tool for human purposes, it can preserve an ethically-interesting sense of autonomy for nature. De-extinction is then not an ethically-inert gesture toward nature—it *can* have deep ecological value. The ontological divide (between "natural" and "artifactual") need not overlap with the ethical divide between having and lacking intrinsic value.

Values often limit one another. It is therefore often wise to adopt the less rigid among the available interpretations of one value (e.g. authenticity) if this significantly increases the fulfillment of another value (e.g. biodiversity).

Once we conclude that de-extinction is not valueless in principle, then comes the question of *when* specifically it is justified.

The primary principle must surely be *primum non nocere*. "Adding exotic species or genes from distant populations may increase local diversity but it reduces integrity" [20]; this may result in net damage to an ecosystem. Introduced invasive species can even threaten biodiversity itself [21]—similarly with *re*introduced species (the longer the time between extinction and de-extinction, the greater the risk). Following existing re-introduction guidelines is therefore a precondition for ethical de-extinction [22].

Even when de-extinction is ecologically beneficial, we may doubt whether it will constitute optimal use of limited resources. Available funds may be better spent on the much cheaper conservation of (the currently roughly 20,000) endangered species [23]. More ominously yet, conservation efforts are fueled by a sense of alarm that extinction is irreversible. By creating a false assurance that "if a species goes away, we can snap our fingers and bring it back" [23], de-extinction may *undermine* conservation efforts. Assuming that ecological benefit is our goal, we must weigh these dangers seriously. The following are considerations that may nonetheless work in favor of de-extinction.

(1) Although cutting-edge technologies are expensive, their prices tend to drop steeply fast. In addition, secondary benefits from de-extinction of certain species may offset the cost-benefit balance. An example is the argument that reintroducing mammoths to the tundra would help transform it into more productive grassland that "could stave off some effects of [global] warming" [2]. (2) Genomic engineering technologies developed for de-extinction may offer powerful new tools to preservationists [2]. Hence, choice between conservation and de-extinction need not be a zero-sum game. (3) This latter realization could work in a different way too. The higher-profile de-extinction can infuse interest in and enthusiasm for environmental causes, thus raising

otherwise unavailable funding for bioconservation too. This extends to de-extinction the idea of "flagship species" (species, such as panda bears, that capture the public's attention)—campaigns for these few species raise awareness for environmental protection far beyond their singular importance as species [24].

In one sense, the above arguments miss a crucial point. By asking which method saves more species per given budget, they uncritically take species as the basic units of biodiversity. However, an arguably better approach to biodiversity takes features (genes) as the basic unit to be maximized. If features are treated as the units of biodiversity value, then some species make larger contributions to diversity and should be differently valued [25]. It follows that de-extinction of certain species may augment biodiversity better than conservation to an extent that would render it cheaper.

The lack of objective determinacy of the basic units of value of biodiversity may re-invoke the claim that all restoration of nature expresses human purposes and therefore creates artifacts. I do not find this objection compelling. That choice is inevitable due to underdeterminacy between two intrinsic values does not turn the chosen value into an instrumental one. The underdeterminacy in the meaning of biodiversity does not as such amount to supplanting a biocentric attitude with an anthropocentric one (as when prioritizing de-extinction of animals we like better or whose commercial value is higher). Yet as argued above, anthropocentric purpose alone is what could make restored nature into artifact in the relevant ethically-problematic sense.

Although our analysis supported the essential and actual possibility of de-extinction's ecological benefit, probable changes to species' environment since extinction and the resultant risks reintroduction may pause to ecosystemic integrity will likely make the overall ecological value of de-extinction quite uncertain in most cases.

Deontology and Justice

Suppose we can choose between two equally costly options: to enhance biodiversity via synthesizing a new species or via "de-extincting" a species humanity has rendered extinct; suppose further that the synthetic biology option offers a slightly higher contribution ecologically; could it be reasonably argued that we nonetheless ought to choose the de-extinction option since, beyond ecological value, humans "bear ethical responsibility to redress" the wrongs they did to species by eradicating them?[2]

The anticipated feasibility of de-extinction has thus surfaced the idea of an obligation of (restorative) justice that humanity might have toward species it rendered extinct.[3] Admittedly, the idea sounds like a case of ethical judgment going berserk. In a related context David Heyd writes about "efforts to protect those species about which [we] feel guilty for having endangered them to the point of extinction… Obviously, this priority cannot be considered a matter of *justice*" ([28] (my emphasis)). It is easy to understand Heyd's sense of obviousness just by thinking what the idea of justice could mean in our case. It would imply that some extinct species have a claim against us, that they have rights that we breached. But how can a taxonomic entity have rights, and worse still, how can our putative corresponding duties remain in force when the right bearers no longer exist? This sounds suspiciously nonsensical.

Strangeness granted, my aim in this section is to show this idea can be given a sensible interpretation. Moreover, pursuing this perspective on de-extinction can reveal valuable insights into the fundamental ethical attitude toward nature.

Three puzzles are raised by the deontological argument for de-extinction: whether species are the kind of entity that can logically be a right-bearer; if they can, whether they do in fact have rights; and, if they do, what those rights in fact are and whether they may require de-extinction. These questions determine the order of my discussion.

According to a common understanding, to have a right is to have a valid claim concerning the protection of one's interests [29]. This entails, in particular, that entities that cannot have conscious aims or desires, and therefore interests, cannot have rights. Joel Feinberg writes that "individual elephants can have interests, but the species elephant cannot" ([30]: 55); accordingly, species cannot have rights. Against this view, it has been claimed that to be a potential bearer of rights it is enough that something be in *X*'s interests even if *X* has no

[2] Donlan et al. [26]. (Theoretically, such ethical responsibility could mandate de-extinction even when it has *no* ecological value.)

[3] "If we're talking about species we drove extinct, then I think we have an obligation to try to do this," says Professor Michael Archer, head of the Lazarus Project team; see Zimmer [27].

(conscious) interest in it, or even the capacity thereof. Indeed, this is how we tend to conceive of certain rights of, say, babies or the comatose. For something to be in *X*'s interests, the necessary and sufficient condition is that *X* can be benefited or harmed. This is the case when it is true of *X* that is has a "good" of its own, without reference to any other being. Then we can coherently speak of *X*'s well-being, of what is desirable or undesirable from *X*'s standpoint. Paul Taylor, who advances such a view, adds, however: "The population has no good of its own, independently of the good of its members…it is individual organisms that alone comprise the actual entities that have a good definable independently of the good of any other entities" ([31]: 69). Speaking of the well-being of a species-population is therefore but statistical shorthand; speaking of the well-being of a species is a categorical mistake: "A species as such is the wrong sort of target for an ethical obligation."[4]

I am not convinced. Firstly, individual (non-person) animals do not have subjective views regarding their well-being. Hence, in assessing their interests, we necessarily use species-derived criteria; the good of an animal in the sense of its basic interests is wholly defined in species-based terms. Now the successful functioning of an individual animal has an evolutionary logic, but it sometimes makes less or no sense from the perspective attributable to the animal itself. Animals' life often includes tremendous inevitable pain, which confers survival benefit but, we might think, is "not worth it" for the individual animals; the same is true regarding the "unreasonable" ordeals animals often endure in rearing and protecting their offspring. Yet, as Richard Dawkins writes, "natural selection is indifferent to the intensity of suffering, except in so far as it affects survival and reproduction" ([33]: 395). The survival referred to clearly expresses the species' perspective. Beyond sacrifice of self-interest to increase the fitness of kin are the various instances of outright self-sacrifice at all levels of the animal kingdom (from amoebae and shrimp to canines and primates) [34]. Inclusive fitness (the theory in evolutionary biology according to which genetic success requires cooperation, even self-sacrifice) suggests that the *conatus* is first and foremost the species', not the individual's. This entails two important conclusions: (1) the good of the species is not comprehensively analyzable into the good of individual animals, and (2) a species is a real natural entity, not just a taxonomic one (as higher taxa arguably are). Speaking of species rights is hence at least *pro tanto* reasonable, it is no categorical mistake.

(When by virtue of a special status that *X*'s interests have others' behavior toward *X* is normatively restricted, this defines *X* as a bearer of rights. And yet, as Paul Taylor rightly explains ([31]: 245–255), there is a widely-used fuller explication of "rights" that makes it conceptually inapplicable to non-rational beings. Now since *X*'s rights by definition entail moral obligations on certain others, we may avoid confusion, while losing no explanatory power, if we revert from speaking in terms of rights to speaking of our moral obligation to further the good of species based on recognizing their special moral status. We now turn to this task.)

For a species to make a claim on us, it is not enough that it has a good of its own—we may be justified in not caring about its good. Rather, we must conceive of its good as valuable. This too is not enough, however. If the promotion of its good is to put a moral obligation on us, that good cannot be of but instrumental value for us (as in "shallow ecology" accounts); for then it is us who ultimately determine the recommended behavior rather than it normatively forcing itself on us. The good of the species must therefore be a non-instrumental, that is, an *intrinsic*, value. This is indeed a common and intuitive view of things: we do not care about the preservation of rain forests because this gives us pleasure, it rather gives us pleasure because we believe rain forests have intrinsic value. Since species have goods of their own, it makes sense to act for *their* sake, and hence non-instrumentally. And yet this too would not suffice. Intrinsic value has multiple meanings [35], and its "non-instrumental" sense is still compatible with moral subjectivism. To wit, that the good of other species is a non-instrumental value means that it is it, not me, that is the *object* of value, but it can still be me who is the *source* of this value judgment. And in such a case, I, who endowed it with value, am equally sovereign to cancel it, thus escaping any possible obligation; this, however, stands in contrast to the inescapability of moral obligation. The value of species must therefore be an *objective* intrinsic value, if indeed we are under obligations imposed by the goods of species.

Now proving that a value is objective is notoriously difficult. We may note, however, that expressions chosen to describe species extinction imply the objective

[4] Rescher ([32]: 80). Ronald Sandler argues for a similar view; see Sandler ([4]: 2).

view. Ronald Dworkin, for instance, writes, "We consider it a kind of cosmic shame when a species that nature has developed ceases, through human actions, to exist" ([36]: 75). John Rawls declares that "the destruction of a whole species can be a great evil" ([37]: 512). Such expressions are telling and arguably intuitive. Beyond the appeal to intuition, however, we can gain insight regarding value objectivity via the following consideration: Since true obligation toward species *means* that we respect their interests, we can advance by examining the idea of respect for species. I will now provide an (inevitably sketchy) analysis of this.

The starting point is the basic attitude of reverence for life. This attitude is expressed for instance in the thought that there is something wrong about destroying lives, any lives, for no (good) reason. People sometimes speak of "the miracle of life" (no difference for that matter how erudite they are in evolutionary biology), implying an attitude of appreciation and wonder in the face of the phenomenon of life. Life has a special, more sublime status compared with non-life. Dworkin writes: "we consider it wrong, a desecration of the inviolable, that a species that evolution did produce should perish through our acts" ([36]: 78). The ideas of sacredness and inviolability attest to special reverence. This attitude is perhaps nowhere as central as in Albert Schweitzer, who writes: "ethics, too, are nothing but reverence for life. That is what gives me the fundamental principle of morality, namely, that good consists in maintaining, promoting, and enhancing life, and that destroying, injuring, and limiting life are evil" ([38]: 93). If anything is respect-worthy, the highest ethical principle is; here Schweitzer expresses this moral attitude of respect as "reverence for life." (The idea of the sanctity of life got very bad press in bioethics[5]; but this clearly expresses a highly skewed vision of the concept. The relevant bioethical debates: (a) often refer to life in specific contexts that are the precise opposite of the thriving that normally characterizes life, concentrating on abnormal situations where "life" is devoid of crucial brain and other functions, dependent on life-support technology, etc.; (b) they focus on quite specific kinds of cases where the value of life clashes with the other fundamental value of human dignity or of autonomy (e.g. debates on abortion ethics). But clearly it is tunnel-visioned to assess the idea of the sanctity of life through these specific, artificial scenarios, while completely ignoring the more normal phenomena of life in nature.)

It may be objected that while respect is an ethical attitude, reverence is a different kind of non-ethical awe. I believe this is wrong. A full explanation is impossible in this space,[6] but I will say the following. This objection is highly prone to question-beggingness: to avoid pointless argument over semantics (i.e. if you deem *X* non-moral, you call its underlying attitude reverence rather than respect), the objector must say something substantive about the different phenomenologies of reverence versus respect and how they connect differently to the moral realm. Likewise one cannot simply stipulate that since reverence is for life and respect is for persons and since the attitude toward persons but not toward life is moral, then reverence is non-moral, for this, again, is the question at issue here. Against the objection, I will show a substantive structural analogy between respect for persons and reverence for life (which I will henceforth call respect for life); this, in turn, will help explain the idea of respect for species.

What is the object of respect for life? Surely, it is life—but how should we understand this? The idea of life is philosophically involved. If, against reductionist theories, we view life as a basic conatus, perhaps not in Aristotelian or Bergsonian terms, but as an irreducible emergent property of certain highly organized systems [39], then life retains the character of a basic impulse, which as such is amorphous. In this sense, it is true to say of life, as it is of freedom, that it is existence that precedes essence. If this is so, if we view life as a pure conatus, in itself devoid of essence, then we understand that specific living things cannot partake in life as in an independently existing Platonic Form, but rather life has to be instantiated ("incarnated") in specific life forms in order to be anything definite at all. What are the relevant forms? Clearly, these are the species. "A species is a living historical form" ([14]: 721). We can see each species as a unique perspective on life, an interpretation, if you will; in this sense we can say with Nietzsche that there *are* only interpretations. Hence we find that a necessary dialectic between life as pure conatus and specific species is inherent in our normal idea of life. Respect for life must therefore be for life-as-life-forms. In this route we arrive from the idea of respect for life to respect for species.

[5] Cf. Peter Singer's title: "Is the Sanctity of Life Ethic Terminally Ill?"

[6] I provide a fuller account of this topic in "Respect for Persons, Life, and Nature" [unpublished].

Now there is an interesting structural parallelism between the idea of respect for species as explained here and the fundamental ethical idea of respect for persons. In both cases there is an attitude of respect for a fundamental source of agency—life in the one, freedom in the other—but in both the attitude in itself amounts to nothing unless redirected toward the necessary embodiment of the agency; thus we get respect for species, following the same logic as we find in respect for persons. Understanding this parallelism confers another dimension of plausibility on the idea of respect for species. Further elaboration cannot be expounded here; we have seen, however, that we can sensibly speak of the interests of species and that an accompanying attitude of respect is sensible too. If we accept this, then we have all we need to establish moral obligations toward species, or, if we wish to use that language, species' rights.[7] What is the content of the obligation toward species? The answer is easy, since only one thing is in species' interest: their continued propagation to the future. Hence we have a moral obligation not to render species extinct.

The follow-up question is of course whether this obligation extends to de-extinction. Now there is a very intuitive sense in which it does. If I kill you, thereby breaching my moral duty, but then serendipitously find out I can resurrect you (say, by praying for your revival), then surely a natural correlate to my duty will be to act for that restitution. (Such secondary obligations arising from the breach of primary obligations are referred to in deontic logic as "contrary-to-duty obligations.") This can also be seen from another angle. If I wrongly killed you, I ought at least to feel guilty. As Rawls rightly explains, moral feelings are partly defined by their specific inclinations to action. Hence, when genuinely feeling guilty, "a person wishes to act properly in the future and strives to modify his conduct accordingly" ([37]: 483). Therefore, if we feel guilty for having exterminated a species (as we assume we should), and if de-extinction is available, it follows that we will be morally inclined to perform it.[8] Finally, it may be sensible to explain a duty of de-extinction not as stemming from the breach of the original duty (as in the preceding analysis), but rather as a continuation of the original duty to protect species from the harmful effects of human civilization. For in a world where de-extinction technology exists, that a species was eradicated may be seen in principle as a temporary limbo status that does not change the original obligation.

Assuming I established an at least minimally coherent idea of a duty of de-extinction, we are still left with the question of scope. This furnishes a daunting list of hard questions (as would any expansion of the realm of justice). I can merely present some major ones.

Under what conditions precisely does the duty arise? What level of responsibility for the extinction entails the duty? Is it only direct responsibility (e.g. sports hunting), or also through indirect consequences of human population growth? Clearly a dichotomy between direct and indirect is untenable here, the spectrum of considerations is very large, where to draw the lines? Is malice, as in poaching or reckless pollution, a relevant consideration or not? Is all of humanity always the responsible party or can it be specific groups? How far back does responsibility go—does it precede modernity, do prehistoric man's actions bind us? Who precisely are the eligible objects (recipients) of the duty? Do all species count equally or are there distinctions in respect-worthiness? What level of threat to human well-being justifies a waiver of the duty and instead legitimizes applying the survival of the fittest norm to human actions? Does humanity have a duty toward the smallpox virus that we eradicated? Do viruses count at all? How to understand the de-extinction duty when the animal's natural habitat no longer exists? Is there a subsidiary duty to restore the habitat too? What are the criteria for a duty successfully discharged? How large of a revived population suffices? What level of identity ought there to be between the resurrected species and the old one to satisfy the duty? This can go on and on.

The potential objections to the analysis I provided in this section are legion. My aim was to show that the initially absurd-sounding idea of a duty of de-extinction deserves a second thought. It was also to present some novel perspectives on how to think about the ecologically-fundamental notion of respect for life.

Playing God

The previous section discussed a possible obligation to perform de-extinction; the concern in this section is in a

[7] It is by now obvious that "species rights" is totally different from "animal rights."

[8] This argument in particular suggests the more general point that the moral case for de-extinction, explained here as an argument from justice, can be re-conceptualized in terms of virtue ethics. I thank a reviewer for this journal for pointing out this possibility. This of course lends further support to the case for de-extinction by showing the breadth of its possible justifications.

sense the opposite: the ethical impermissibility of de-extinction, based on the "playing God" argument.

The charge of playing God is made when humans "make choices concerning abortion, genetic engineering, the basic conditions of future life on the planet, interference with evolutionary processes, or any radical tampering with the allegedly 'natural' development of human beings and their environment" ([40]: 4). The accusation is of overstepping humanity's proper boundaries of action by illegitimately interfering with what is not under human authority. It is easy to understand why according to this view de-extinction is a paradigmatic transgression: by using cloning, de-extinction tinkers with the building blocks of creation, so to speak; in addition, de-extinction may create some "unnatural" transgenic organisms; and, maybe worst of all, de-extinction attempts to revive the dead. In short, de-extinction integrates three of the paradigmatic divine roles: creation, definition of the natural, and revival of the dead.

Now the strong urge to view all this as downright moral confusion is strengthened by the seemingly straightforward diagnosis of the origin of the mistake. An imagined sin of playing God is a vestige of the obsolete worldview of a well-ordered cosmos as *scala naturae*, where processes created by or emanating from God define for all eternity what is natural, and where each creature's God-designated role must not be exceeded. Diagnosis granted, the persistence of playing God arguments even after the alleged confusion has been made self-conscious and often among the non-religious warrants a second consideration of its merit. While this is not the space for that investigation, ethical intuition arguably points to a virtue-ethical concern: a certain virtue of humility (corresponding to the well-known accusation of hubris) is imperative for a worthwhile relationship with our environment. In a related context, Bernard Williams spoke of a "Promethean fear…of taking too lightly or inconsiderately our relations to nature" ([16]: 239). Against this basis, I will briefly list some considerations specific to de-extinction.

Firstly, Michael Archer's claim, "I think we played God when we *exterminated* these animals" ([27] (my emphasis)), is revealing. Beyond demonstrating the difficulties in applying the playing God argument generally, it presents de-extinction as based in guilt. Guilt is closer to humility than to hubris, thus potentially neutralizing the playing God charge.

Secondly, and on a related vein: to the extent that de-extinction is motivated by biocentric ideas of enhancing nature, it can be distinguished from the narcissistic attitudes often characterizing other projects to which the playing God accusation is directed (such as radical, "transhumanist" enhancement). Again, the ethical attitudes of love and respect for nature seem to supplant self-aggrandizement or hubris.

Thirdly, to the extent de-extinction (perhaps unlike synthetic biology) revives a more or less authentic extinct species, the charge of "unnaturalness" would refer only to the process, not to the product. However, what counts as a problematic process is far from clear. As Ronald Sandler rightly claims: "People have been intentionally engineering organisms, including interspecific ones, since the beginning of agriculture" ([4]: 4). Nobody accuses them of playing God. Notice, interestingly that, to the extent the playing God charge has merit, there seems to be a tradeoff between process and product in assessing different de-extinction techniques: while cloning yields a reliable replica of the extinct animals and thus does not create a new species, its technique is "unnatural"; conversely, while back-breeding is to an extent an age-old technique relatively immune to the playing God charge, it may create a new chimeric product.

Lastly, the charge of playing God can be interpreted differently: the core vice is not that of usurping a role not ours, but the hubris of thinking we know how to improve on nature. (According to this view, if indeed we had the requisite superhuman knowledge, the task would be permissible.) Given the complexity of ecosystems, the conviction that de-extinction will help rather than disrupt biological integrity may therefore seem hubristic. The playing God charge as presently interpreted reminds us of our ignorance and signals that de-extinction may be rash and possibly violent.

Utility

The preceding sections analyzed axiological and deontological considerations, as well as some pertaining to virtue ethics; the ethical assessment of de-extinction should next address consequentialist considerations.

While the first two sections advanced ideas regarding intrinsic value in nature, utilitarianism recognizes only preference satisfaction or pleasure and avoidance of pain as intrinsic values. Intrinsic value, charitably interpreted, resides in all sentient beings, but nowhere beyond. This rules out any intrinsic value in ecosystems, landscapes, forms of life, and so on ([41]: chapter 10). Related considerations in the previous sections are therefore largely irrelevant from the utilitarian perspective. Since biodiversity or respect for life as such are not the values guiding the utilitarian approach to de-extinction, no presumption of equality between all species exists; the opposite is the case: the "existence value" of species is valued differentially according to their potential to provide goods [42].

The following reviews the major considerations relevant for a utilitarian calculus of de-extinction (in-depth analysis of each exceeds our scope).

Factors associated with positive utility:

(1) Recreational value. Watching certain resurrected species, especially "charismatic megafauna," is expected to be an exciting diversion for many. Indeed, this is often considered a central motivation for de-extinction.
(2) Advancement of scientific knowledge. De-extinction could offer unique opportunities for studying the life history and biology of ancient-revived species. Such knowledge, beyond its intrinsic worth,[9] can have practical value. The influenza virus responsible for the 1918 pandemic was "resurrected," allowing insight into prevention of future pandemics [43]. Complementarily, new drugs may be derived from extinct plants [3]. In addition, de-extinction's exoticness may help science generally by raising popular awareness to its feats.
(3) Technological advancement. In his review of de-extinction, Ronald Sandler concludes that "the considerations in favor of de-extinction are largely techno-science-oriented, not conservation-oriented" ([4]: 6). The most likely benefits would be "advances in genetic engineering, such as the targeted replacement of large stretches of genomic DNA" ([3]: 33). De-extinction-related biotechnological advances will be applicable to many species, humans included.
(4) Environmental benefits. Broadly speaking, "there is ample evidence that biodiversity is…massively beneficial to humanity" ([44]: 221). The massive loss of species causes the destruction of the natural systems that purify the world's air and water. Any contribution of de-extinction to such processes could theoretically have very high dollar-value. Such contribution would also happen indirectly, through usage of de-extinction methods in bioconservation [45].
(5) Educational and cultural values. The environmental education associated with de-extinction could boost the other utilities, notably, environmental protection and funding for environmental causes. When an extinct species had cultural value, de-extinction could satisfy preferences in this way too ([4]: 3).

Factors associated with negative utility:

(1) Unwise expenditure. De-extinction may prove a bad investment, as the chances that resurrected species will not last are realistic [5]. Moreover, de-extinction may plausibly soak up funds that could create higher overall utility if used otherwise.
(2) Health concerns. "Newly de-extinct creatures might prove excellent vectors for pathogens. An extinct animal's genome could also conceivably harbor unrecognized, harmful endogenous retroviruses" ([3]: 32).
(3) Environmental hazard. If the ecosystem that formed the habitat of the extinct species has changed significantly, the reintroduced species may prove to have become a pest (akin to non-de-extinction-related introduced species that become invasive in their new habitat).
(4) Harm to animals. Utilitarianism that views all sentient beings as moral patients, must calculate animal suffering. Suffering from cloning experiments, for example, could be due to both the rampant medical pathologies of the clones and the unnatural gestational surrogacies.[10] We should remember, however, that experiments with cloning can have multiple benefits beyond the de-extinction context.

(There is an important qualification to the last parameter of animal welfare. This parameter is unique in that considerations of utility ought to be constrained by a

[9] The advancement of knowledge may be seen as an objective value, beyond preference satisfaction.

[10] On cloning and de-extinction see Gamborg [6].

deontological consideration, namely, that beyond a certain level and probability of harm de-extinction may cause, we should refrain on moral grounds from performing it, despite sacrificing greater utility. Now the patients of harm may be (a) the de-extinct animals themselves, (b) other animals recruited to the de-extinction process (e.g. surrogate mothers, in cloning), and (c) animals in the wild that are naturally affected by the de-extinct animal. (Since the third category involves only indirect effects of our actions, I believe it is best accounted for by a balance between utilitarian and ecological values, not deontology.) The general question of when deontological constraints kick in to override greater utility is a notoriously difficult question in moral theory; it is not specific to de-extinction, however, and there is no reason to think de-extinction will cause a large animal welfare problem ([4]: 5), so I will not deal with it. The point I do want to emphasize here is rather the difference between the first and second categories of affected animals. While a duty not to harm other animals in the process is a duty of the "regular" type (i.e. toward moral patients who exist or will exist independently from our action), the duty not to do harm to the de-extinct animals belongs to the special category of duties arising in the context of *creating* moral patients. Here the logic of the non-identity problem is at work, which may mean that our duty of care is limited to not creating animals whose lives will be "not worth living" ([46]: chapter 16). If true, the threshold for sacrificing greater utility in the name of the duty not to harm is therefore much higher.)

Utilitarianism never *truly* delivers on its promise, since a complete evaluation of consequences is virtually never possible in real-world open systems. In concluding this section, we should emphasize that this problem is especially severe in de-extinction. Due to the phenomenal number of relevant considerations whose utility values are unknown as well as of unknown relevant considerations, utilitarian assessments of biodiversity must revert to speaking of imprecise "option values" [47]. The usefulness of future-oriented utility considerations under profound uncertainty is severely restricted; de-extinction is a paradigmatic particular case.

De-Extinction, Aesthetics, and Ethics

In concluding their assessment of the risks and benefits of de-extinction, Sherkow and Greely write: "The last benefit might be called 'wonder,' or maybe colloquially 'coolness'. This may be the biggest attraction, and possibly the biggest benefit of de-extinction. It would surely be very cool to see a living wooly mammoth" ([3]: 33). Sherkow and Greely's assessment may, under certain conditions, end up true, and here too we shall conclude with remarks on the "coolness or wonder" argument for de-extinction. *Pace* Sherkow and Greely, however, there is good reason to distinguish "coolness" from "wonder." While the first refers to some diversion, best classified under recreational utility, the latter denotes aesthetic appreciation or value. Aesthetic value is a paradigm of intrinsic value—it is desired (also) for its own sake. Other things being equal, promoting intrinsic value is good (this is an analytic statement); it is therefore good *ceteris paribus* to promote aesthetic value. If de-extinction can promote aesthetic value, then in this respect it is good and gives us reason to perform it. However, even when de-extinction is aesthetically justified, in the context of this paper we are interested in a further question: how is aesthetic value relevant for the *ethics* of de-extinction? I conclude this paper with some brief remarks on the ethical dimensions of promoting aesthetic value through de-extinction. Concomitantly, we will have to verify that de-extinction can in fact be an agent of such promotion.

The question of the ethical dimension of the aesthetic contribution to nature falls under the general topic of the connection between aesthetics and ethics—a difficult topic that remains relatively obscure in ethical theory. Plato, for whom the Forms of the Good and of the Beautiful or Fine (the *Kalon* [τὸ καλόν]) were of particular importance, already sketched much of the puzzlement. The two Forms are repeatedly drawn together, at times presented as interchangeable,[11] though mostly their distinctness is affirmed.[12] In one place Socrates proposes as conclusion that "the beautiful is the cause of the good," only to admit, reluctantly, that this implies their *non*-identity.[13] The puzzlement concerning their precise relation is left unsolved, but the general insight is arguably that the good is fine always, though not so the reverse.[14] Rachel Barney insightfully explains that the ethical

[11] See *Meno*, St. 77, *Symposium*, St. 201ff.
[12] See Rachel Barney's exquisite review: [48].
[13] *Greater Hippias*, St. 296, trans. Benjamin Jowett.
[14] In the *Philebus* (St. 65) we are even given a formula of sorts, where the good is a function of three elements: beauty, proportion and truth.

attitude toward the good is informed and shaped by the attitude of admiration directed at the *Kalon* [48]. (We can hence understand why training for virtue in the ideal Republic must be based on intensive education in music.) Accepting this general insight, we should inquire about the conditions under which the aesthetic not only contributes to the ethical but *is* ethical.

"Aesthetic experience is among the most common starting points for an environmental ethic" ([49]: 127). It is easy to agree with this observation, but can aesthetics and environmental ethics remain conjoined beyond starting points? They can, due to certain conditions that hold in or for nature. (1) A common approach in aesthetics takes artworks, i.e. artifacts, as the paradigm objects of aesthetic assessment. It is often overlooked how this prejudices in favor of a gap between ethics, which deals with sentient beings, and aesthetics (leading consequently to the "overridingness" of ethics). When in environmental thinking we examine natural and, specifically, *animal* beauty, however, the dichotomy quickly loses its grip. (2) For aesthetic value to be simultaneously ethically significant it must not rely on arbitrary taste (which would re-invoke "coolness"); it must rather rely on aesthetic properties intrinsic to the things themselves. An important model for this is the notion of "functional beauty"—beauty that arises out of a thing's function. As Glenn Parsons demonstrates, functional beauty is indeed central to the aesthetic evaluation of animals [50]. A cheetah for example is aesthetically pleasing in view of the fitness between its shape and its amazing hunting functions—the cheetah's "looking fit" for hunting is inseparable from the judgment about its beauty. Functional beauty is a clear instance of Kant's idea of "dependent beauty"—a concept-mediated beauty judgment ([51]: section 16). When function participates in an organism's beauty, then beauty is intertwined with the idea of the organism's *telos*, and thus of its good, which in environmental ethics is the object of ethical concern. The ethical and the aesthetic are then essentially associated. (Animal beauty can also be of the "free beauty" (i.e. non-conceptually-mediated) kind [52]. Robert Elliot suggests a theory of aesthetic value that amounts to ethical value under that condition too ([17]: 58–73).) (3) Functional beauty points at another important condition for the association of aesthetics and ethics, namely that the aesthetic is not understood narrowly as "beautiful" but in a more inclusive sense of "aesthetically pleasing." Arguably not all animals are beautiful in the narrow sense [53], but all can exact the *Kalon*'s sense of admiration once we apprehend the wondrous ways in which their build is adapted for their struggle for survival. This admiration can be experienced as an aesthetically pleasing sense of "wonder" (re-invoking Sherkow and Greely's view). These wonder and admiration are what simultaneously animates a "land ethic" that, as in Aldo Leopold's famous quote with which the paper opened, enjoins us to preserve the (integrity, stability, and) *beauty* of the biotic community.

Environmental ethics can therefore recognize ethical value in increasing the wondrousness of nature. De-extinction can indeed contribute to this, for example by reviving wonder-eliciting mammoths. Skepticism, however, might here rely on the thought that de-extinction's artificiality would undermine aesthetic value. I shall conclude by addressing this worry with three brief comments. (a) To the extent that animal beauty is "free" (in the Kantian sense), its genealogy is irrelevant. (b) In case of "dependent beauty": if the facilitating concepts are scientific, then de-extinction should not detract from and may even enhance the sense of admiration, secondary to a heightened understanding of the mechanisms of functioning. If the understanding that underlies aesthetic appreciation is not scientific but historical, that is, if it relies exclusively on the virtue of naturalness, then this could potentially undermine beauty. I shall not develop the answer to this challenge here, as it follows the lines of the answer to the parallel criticism from naturalness discussed in Section I above. (c) A special sense of aesthetic wonder is the aesthetic category of the sublime, and one may indeed expect that some sense of sublimity would be experienced in the face of the mighty mammoths. But then the question for de-extinction is: can technologically-revived mammoths retain the ability to evoke the experience of the sublime? Skepticism is not unwarranted, for how can something of our own making project sublimity? I believe that sublimity is not ruled out by de-extinction. A mighty storm at sea can be sublime; now if I could ignite such a storm, would it ruin my impression of sublimity? Arguably not, for the crucial point is not whether I can cause it, but whether I can *control* it. If I can be no more than a helpless spectator in the face of the awesome forces I unleashed, then the sublime would arguably still loom large.

Conclusion

De-extinction still sounds like science fiction, yet it is actually occurring. While the idea of reviving the dead is philosophically loaded in many ways, this paper focused on the ethics of de-extinction. The analysis in this paper did not support a strong overall *prima facie* ethical recommendation either for or against performing de-extinction—it rather presented various arguments for both sides. Rather than seeking a general verdict on de-extinction's permissibility, my main interest was to analyze the basic ethical questions it involves. On that more general plane, the discussion interestingly suggested that, due to its special character, de-extinction tests the limits of our ethical notions from multiple angles. This was true with respect to ecological values of conservation, the scope of justice, the vague interface between aesthetics and ethics, to an extent, even the application of the playing God criticism, and even the questions of the limits of usefulness of the utilitarian calculus.

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