The Unnaturalness Objection to De-Extinction: A Critical Evaluation

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Abstract: *De-extinction of species has been criticised for being unnatural, as have the techniques that might be used to accomplish de-extinction. This objection of unnaturalness will be dismissed by those who claim that everything that humans do is natural, by those who claim that naturalness is a social construct, and by those who argue that ethical concerns arising from considerations of unnaturalness rest on a failure properly to distinguish facts from values. However, none of these criticisms of the objection of unnaturalness is convincing, for reasons I will explain in this paper. The objection of unnaturalness might be motivated by concerns about either: (i) the attitude to nature that underpins de-extinction practices; or (ii) the consequences of interfering with nature. I show that objections of type (i) are rare in the literature, while objections of type (ii) can generally be ameliorated by working with cultures that have ties to the flora and fauna at issue, careful research into the value and nature of ecological systems, limiting risky activities, and limiting the use of de-extinction processes whenever their consequences are unclear. I conclude that the unnaturalness objection to de-extinction is of real but limited force. It gives reasons for caution rather than prohibition.*

Keywords: *de-extinction, naturalistic fallacy, ethics*

1. Introduction

Is de-extinction unnatural? The answer, clearly, is yes. At the very least, de-extinct creatures will be unnatural in their mode of creation, there being a clear difference between the evolutionary process and the technological processes that could be used to recreate extinct species. It is, I suggest, even probable that de-extinct animals will be unnatural in their physical constitution, since de-extinction methods are unlikely to be able to bring back exactly what has been lost.[1] For example, even if a de-extinct 'mammoth' had precisely the same genetic make-up as some ancient mammoth, the ecological system and epigenetic factors that influence the appearance, physiology and behaviour of the two mammoths would almost certainly differ (see, for example, Heard and Martienssen.)

According to Kurt Bayertz, '"naturalness" is intuitively regarded as a value by most people' (133). Combining DNA through artificial insemination and in vitro fertilisation has been criticized as being 'unnatural'. Tuija Takala writes that '[even] those who come from a philosophical background can catch themselves thinking, "That is unnatural!" and finding grounds for suspicion from the thought' (15). Since unnaturalness is commonly deemed a bad thing and since de-extinction is manifestly unnatural, it will be little surprise that a common objection to de-extinction is that it is unnatural, and therefore bad. This objection, which I will call the 'unnaturalness objection', appears in various forms in the writings of such authors as Anne Chapman, M.R. O'Connor, Gregory Pence, Ronald Sandler, Mark Sheehan and Takala. This paper critically evaluates the unnaturalness objection to de-extinction.

Section 2 briefly outlines three de-extinction techniques. Sections 3, 4 and 5 consider three counterarguments to the unnaturalness objection and show that none of them is persuasive. Section 3 evaluates the argument that de-extinction cannot be criticised for being unnatural because everything humans do is natural. Section 4 considers the argument that criticisms based on unnaturalness are unconvincing because naturalness is a social construct. Section 5 explains why claims that the naturalness of an action affects the ethical status of that action are commonly dismissed for failing to distinguish between facts and values, and how the unnaturalness objection to de-extinction can avoid such objections. Section 6 considers ethical objections to the unnaturalness of de-extinction based on deontological concerns, in particular

arguments that refer to integrity and disgust. Section 7 considers objections to de-extinction based on consequentialist considerations, responding that these may be resolvable through research into ecological systems, limiting risky activities, and limiting the use of de-extinction practices when their consequences are unclear. Section 8 is the conclusion.

2. Three Commonly Proposed De-Extinction Techniques

The – arguably – least technologically invasive approach to de-extinction involves so-called 'back-breeding': the selective breeding of members of an existing species that retains some of the genes of an extinct species to create organisms that resemble the extinct species. Using this technique, the Tauros research team is selectively breeding cattle to recreate animals resembling aurochs, the ancestor of today's cattle pictured in early cave drawings (The TaurOs Programme). The same technique is being used to try to produce an Abingdon Island giant tortoise from tortoises identified as having an overlapping genome (O'Connor 57). Technology's role in this practice is limited to identifying the genes of the lost species, finding living individuals with a similar genome, and guiding the selective breeding programme.

A second de-extinction technique involves somatic cell nuclear transfer, a form of cloning. A nucleus from the cryogenically preserved cells of an extinct species is inserted into an egg cell provided by a member of a closely related species (Ogura, Inoue and Wakayama; Richmond, Sinding and Gilbert). The resulting embryo will have mitochondrial DNA from the host, but nuclear DNA from the extinct species. The organism produced will be a genetic chimera, because it will contain DNA from two different species, but phenotypically it will closely resemble the extinct species.

A third approach to de-extinction uses genome editing to compensate for a lack of the living cells needed for true cloning. Once the organism's genome is known, genome editing can be used to splice synthetic copies of the organism's genes into a close relative's DNA until the genome-edited organism resembles the extinct species. For example, an elephant genome might be edited to create a creature resembling a mammoth (Shapiro 44-46), or the genome of the band-tailed pigeon might be edited to create a creature resembling a passenger pigeon (Novak, 'The Crispr Craze Takes Fight: Adding Birds to the Crispr Zoo'). Like back-breeding, this

technique relies on there being a living species sufficiently closely related to the extinct species. It also requires an understanding of which parts of the species' genome are important in determining the species' defining characteristics.

3. Are All Human Actions Natural?

It has been argued that everything humans do is natural (Bayertz; Takala 16; Norman 2). Nevertheless, a coherent and useful distinction can be drawn between the natural and the unnatural. Consider, for example, the claim that animal breeding can be more or less natural. Natural methods of animal breeding require farmers to learn the conditions under which animals become willing and able to reproduce, and to adapt their farming techniques accordingly. Less natural techniques replace animals' natural behaviour with technological interventions, such as artificial insemination, embryo transfer, and other practices that achieve the desired outcomes. Similarly, de-extinction techniques are unnatural as they involve technological interventions and cause changes to organisms that would not happen without those interventions.

If the distinction between the natural and the unnatural is treated as a matter of technological intervention and variance from what would occur without human intervention, naturalness will come in degrees, and it is sometimes spoken of in this way. For example, Pence writes that 'nuclear somatic cell transfer is … one step along a spectrum of … techniques', and implies that the spectrum varies from less to more technologically invasive (194). That naturalness is a matter of degree will make it difficult to set sharp limits based on concerns about naturalness. However, this does not mean that there is no point in making the distinction between more or less natural practices; if it did, there would be no useful distinction between a bald person and someone with a full head of hair.

Somatic cell nuclear cell transfer and gene editing require technological skills and equipment that are under development and not yet reliable. These techniques are unlike anything that occurs without the use of invasive technology. They involve a transfer of DNA between species that would not otherwise occur. If the 'It's unnatural' objection has any force, it would be expected to apply to these techniques.

At the other end of the spectrum, back-breeding might be thought the most natural approach to de-extinction. Back-breeding is similar to selective breeding processes used for millennia to create agricultural plants and domestic animals. With the exception of genome sequencing and tests to check the genomes of offspring, it need not be technologically invasive. It only relies on organisms' pre-existing genetic make-up and their evolutionary relationship to the extinct species. Once the desired genetic make-up and the animals' existing genetic make-up are known, the only intervention required is restricting available reproductive partners in a suitable environment. If naturalness is a concern, back-breeding may raise fewer objections than more technologically intense processes.

Although back-breeding is similar to common-place practices and involves less invasive interventions than nuclear cell transfer and gene editing, it may still be vulnerable to the 'It's unnatural' objection. O'Connor introduces the 'It's unnatural' objection when she writes, 'Whether these offspring [of back-breeding] would be the "real" thing depends on whether you would describe this sort of human tinkering as natural or unnatural, real or artificial' (57). Selective breeding practices may be historically and geographically widespread, but they have caused harm attributed to their interference with nature as well as their consequences (D'Silva and Stevenson; Gamborg and Sandøe). Thus, a similarity with widespread human practices does not, on its own, avoid the 'It's unnatural' objection.

4. 'Natural' as a Social Construct

To say that naturalness is a social construct is to say that what makes it true or false that something is 'natural' is a fact about a society rather than a fact about the world. If naturalness is a social construct, then any claim that de-extinction's unnaturalness raises ethical concerns is a claim about the society and the attitude towards de-extinction held by members of that society. Social constructions of unnaturalness can be criticised from a cultural or political perspective. However, unnaturalness objections can refer to a conception of naturalness based on more than social attitudes.

The concept of naturalness has been manipulated and misused through cultural interpretations of the objects and practices to which the word 'natural' applies, but this is not an

indication that the concept is a social construct. There is a concept of naturalness that refers to the state of the world rather than a cultural attitude; this concept is enough to make the unnaturalness objection worth evaluation. One example is the repugnant laws against interracial marriage in the United States that remained in force until 1967 (Pascoe). Such laws were commonly based on the claim that interracial marriage was unnatural. This use of the term 'unnatural' stemmed from cultural and political beliefs about white supremacy. The race classifications at issue are nonsensical because they purport to point to natural features of the world that do not exist (Cavalli-Sforza; Omi). Thus, ideas about miscegenation being unnatural are not only racist but also scientifically false. Accounts from the discourse of the 'unnatural', clearly, can be fallacious.

5. The Naturalistic Fallacy

Arguments commit the naturalistic fallacy when they reason from a claim that something is natural to a conclusion that it is good (Cole et al. 48; Ball 212-13). The naturalistic fallacy is related to Hume's ethical law, which argues that one cannot deduce ethical normative claims from descriptive accounts of what 'is'. But assuming that what is 'natural' should remain, is as much a violation of this ethical principle as assuming that science ought to repopulate the threatened and the extinct. There is, in this sense, an 'is-ought fallacy', where a conclusion about what *ought* to be the case is derived from statements about what *is* the case in a reductive way. The argument that whatever is unnatural is bad is a version of the argument that whatever is natural is good, so this argument also commits the naturalistic fallacy. If the argument that the unnaturalness of de-extinction raises ethical problems relies on an assumption that everything unnatural is wrong, this objection to de-extinction can be quickly rebutted.

The unnaturalness objection to cloning has been said to rely on an unstated assumption 'that everything unnatural is wrong' (Pence 194). If Pence is right, then objections to de-extinction practices based on an unnaturalness objection to cloning are also likely to rely on this assumption. The claim that 'everything unnatural is wrong' could be a deontic claim – that is, a claim that unnatural actions are wrong in themselves – and this approach is discussed below. However, Pence treats this as a criticism of the consequences of unnatural actions. He argues

that this form of reasoning is flawed, mentioning antibiotics, artificial insemination and animal breeding as counterexamples, that is, cases where something unnatural had good consequences (194). Antibiotics, artificial insemination and animal breeding have harmed humans, other animals, and the environment (D'Silva and Stevenson; Gamborg and Sandøe; Ventola). However, arguably the net effect of these technologies is good, although they would have caused less harm if their use had been limited in certain ways. Similarly, it would be fallacious to argue that naturally-evolved species have good consequences just because they are natural, and genetically engineered species have bad consequences just because they are unnatural.

There are two ways that objections based on unnaturalness can avoid relying on this assumption. First, the 'It's 'unnatural' argument risks employing the idea of the 'unnatural' to refer to the kind (or form) of action being carried out rather than referring to a state of the world. One can call this a 'deontological' approach even as a similar argument can be made from a virtue ethics perspective. Second, the conclusion that something is wrong because it is unnatural can be based on an unstated assumption that being unnatural in the relevant way will lead to harmful consequences, call this the consequentialist approach to the unnaturalness objection.

6. 'Unnaturalness' as a Deontological Concern

Deontological forms of the unnaturalness objection use the concept of naturalness to describe the intentions and attitudes that lie behind the actions, or the form of the action, not just facts about the interventions. For this reason, two actions that appear equivalent on a more consequentialist way of thinking about what it means for something to be natural could be regarded as importantly different. This kind of objection to the unnaturalness of a practice assumes that its unnaturalness affects its value. Three deontological versions of the unnaturalness argument are discussed below.

6.1 'Natural' as a Thick Concept

Sheehan argues that 'natural' is what philosophers call a 'thick' concept, that is, a concept that expresses both fact and value (182). Other examples of thick concepts include 'generous' and 'cruel'. To say that an act is cruel is to say both that it has negative value and that it involves a particular kind of action that could be described in terms of facts. Just as a cruel action is wrong because it is cruel, even if it has good outcomes, an act that is unnatural (in some relevant way) would be wrong because of the kind of action it is, rather than because of the consequences of the action.

To understand Sheehan's analysis of natural as a thick concept, imagine a world where wealthy athletes can undergo gene-editing to improve their speed. Arguably, such gene-editing would mean that the times achieved were unnatural. This would alter what it meant for someone to be among the world's fastest runners. The ge-athletes would be in a class of their own and could no longer claim credit for their achievements relative to athletes who did not use gene-editing. This would, in turn, reduce the value of the achievement. Similarly, '[when runners say] that they wouldn't take performance enhancing drugs because "they're unnatural," they are voicing resistance to a threat to the constraints within which their actions can be achievements' (Holland, cited in Sheehan 185). Increasing the unnaturalness of the action alters the parameters of the action in ways that mean that the action cannot realise certain desirable values. Thus, what it is for the action to be a particular kind of action is determined by the conditions in which it occurs (rather than the consequences alone), and these conditions are sometimes evaluated in terms of naturalness, where this has connotations about both the nature of the conditions and their ethical status.

Sheehan's analysis of the unnaturalness objection suggests an interesting and innovative approach to considering de-extinction. On this approach, the ethical status of any de-extinction project will be affected by the motivations and intentions of those orchestrating the project. Hence, de-extinction projects would need to be evaluated individually. Ben Novak, a supporter of the passenger pigeon de-extinction project, implies that bringing back this species will decrease the rate of extinctions of other species in the areas in which it is introduced ('The Passenger Pigeon: The Ecosystem Engineer of Eastern North American Forests'). Such a project

would be ethical inasmuch as it does not undermine its intended outcomes. Conversely, Stanley Temple suggests that conservation efforts are supported by people because 'extinction is forever', to use a common slogan. If de-extinction reduces people's motivation to protect existing natural environments, then de-extinction projects that aim to reduce the number of extinct species are incoherent, and hence unethical, unless they are inextricably coupled with measures that protect vulnerable species and ecological systems.

6.2 Integrity and Violating Species Boundaries

The unnaturalness objection is sometimes treated as a concern that an action violates the integrity of a species. Objections based on a claim that an action is unnatural because it violates integrity can be consequentialist, that is, express concern about the consequences of violating a species' integrity, or non-consequentialist, that is, claim that a species' integrity has intrinsic value. Sandler refers to a non-consequentialist version of this criticism when he claims that 'the unnaturalness objection to transgenic biotechnology (including deep de-extinction) depends upon species boundaries having ethical significance, such that creating transgenics somehow violates them' (357). Sandler gives two arguments for rejecting the claim that this is even a prima facie reason for rejecting de-extinction. Christian Gamboeg and Peter Sandøe also refer to a non-consequentialist version of this argument when they argue that concern for the integrity of species is a poor argument against genetic modification. However, the arguments given by Sandler and Gamboeg and Sandøe are flawed.

Sandler points out that genetic modification is routine in agricultural and medical contexts and implies that this is a reason to accept that it does not raise ethical issues (356-57). However, that some action is routinely carried out does not show that the action is ethical. This is a version of the is-ought fallacy explained in section 5; that something is the case does not show that it ought to be the case. Forest destruction for economic gain is routine, but this does not mean that it is ethical. Thus, this argument of Sandler's against the unnaturalness objection is ineffective.

Sandler also argues that the fact that it is not considered unethical when species interbreed without human intervention is a reason to think that transgenic biotechnology is not unethical (357). It is unsurprising that species interbreeding without human intervention is not thought immoral; when members of different species interbreed without human intervention, there is no moral agent that might be acting unethically. However, when humans engage in practices that occur naturally, that is, without human intervention, they can be acting unethically. For example, wild dogs fighting is not immoral, but organising dog fights for human entertainment is immoral. Contexts and the agents involved affect the moral status of actions.

Gamboeg and Sandøe argue that violating the integrity of species through genetic modification can be justified. They write:

> Returning to animal welfare for a moment, it might be asked how respect for integrity benefits the animals…. [Broiler chickens] experience leg problems as a result of over-rapid juvenile growth…. Is it not plausible to hold that breeding for improved health and a reduction in susceptibility to naturally occurring diseases is an unconditionally good thing? (139)

However, this response also fails to show that concerns about the integrity of species are unfounded. They could be well-founded and yet be prima facie moral concerns, that is, moral concerns that ought to be given second place to concerns about wellbeing. If this is the case, then species integrity ought to be protected to the extent that it can be without harming wellbeing.[2]

6.3 Disgust at Frankensteinian Creations

Concerns about de-extinction could express a disgust of Frankensteinian creations due to perceived abnormalities and violations of bodily integrity. For example, one research group investigating found that some '[p]articipants … selected … abnormality reasons … to explain their disgust at a bodily violation…' (Russell and Giner-Sorolla 2011, cited in Wielenberg 120). Leon Kass describes human cloning as 'a major violation… of our given nature as embodied, gendered and engendering beings – and of the social relations built on this natural ground' and,

as such, to justify revulsion and disgust ('The Wisdom of Repugnance' 152). De-extinction methods include cloning and techniques that resemble cloning, so perhaps they similarly merit disgust. Repugnance is a useful tool for making moral decisions quickly. However, repugnance is only a useful tool when that repugnance is justified. If de-extinction leads to feelings of repugnance, those feelings are based on something. If they are based on something, then, as argued below, we can take the time needed to explore the reasons for those feelings of repugnance, and whether those reasons are justified, because de-extinction need not be rushed.

Although disgust is an unreliable guide to wrongness (cleaning up vomit is disgusting, but ethical), disgust is a valuable tool for moral judgement. Robert Fischer suggests that moral emotions are tools for so-called 'fast thinking' (686). As such, disgust is a moral emotion that tracks certain states of the world and serves as an heuristic to guide actions (Fischer). Disgust and other moral emotions, such as empathy and guilt, allow people quickly to process morally relevant features of their environment. Shame or disgust at the thought of dog-fighting makes it less likely that someone will attend a dog fight on an impulse. If this analysis of moral emotions is correct, when agents justifiably take a state of the world to be wrong, a reaction of disgust to that state of the world is a reliable indicator of badness or immorality.

Although moral emotions like disgust can be valuable when quick decisions are needed and for limiting impulses, deciding whether to pursue de-extinction does not require quick action or impulse control. Unlike the urgency with which we must stop destroying environments needed to sustain species at risk of becoming extinct, there is no rush to pursue de-extinction. The more time put into considering the advantages and disadvantages of pursuing de-extinction and methods of pursuing de-extinction, the more likely it is that the results will be positive rather than negative. If the disgust reactions some people have to genetic engineering and cloning point us towards an underlying moral issue, we have the time to uncover that underlying issue rather than use disgust itself as a guide. If no underlying moral issue is identified, disgust may be morally unjustifiable.

7. Consequentialist Versions of the Unnaturalness Objection

In contrast to deontological objections to unnaturalness, the claim that something is unnatural can express concern about the effect of interfering with nature. Concerns about unnaturalness of this kind generally arise from fears about human ignorance about what is valuable or ignorance of the consequences of actions. On this view, the degree of concern about unnaturalness will often reflect the extent of the technological intervention. Unnaturalness becomes almost scientifically measurable. This approach to unnaturalness is mainly consequentialist, linking into concerns about the outcomes of interventions. Three versions of this form of the objection follow.

7.1 Knock-Off Reproductions

The 'It's unnatural' objection may be an expression of dissatisfaction with the products of de-extinction processes. In other words, it may reflect a sense of a lack of something like aesthetic value. Using mathematical algorithms or Adobe Stock to recreate lost paintings arguably fails to make up for the loss of the original artworks (Nudd; Lillemoen and Foss; Sagoff; Ricardo 35). Even if the recreations were indistinguishable from the originals, some people will still hold that they lack something important. De-extinction will produce modified versions of extinct life forms rather than exact replicas of what has been lost. De-extinction will create organisms that carry mitochondria or genetic material from species other than the target of the de-extinction attempt. De-mammoths will carry DNA from elephants, de-aurochs will carry DNA from modern cattle, and de-huia could contain genes from the saddleback or kokako (Shapiro; The TaurOs Programme; Campbell). De-extinction practices aim to recreate species, as well as individual members of a species, and de-species may also be considered reproductions rather than replicas. For example, de-extinction techniques that rely on DNA recovered from a small number of members of an extinct species are unlikely to recreate the genetic diversity that once existed within the population of extinct species. Even if de-extinct organisms were genetically identical to lost species, there would be an inevitable causal break with the original process of evolution. Moreover, de-extinction cannot recreate important aspects of the environments within which the original organisms lived, including epigenetic influences, chemical nutrients,

bacteria and symbiotic flora. If research teams in Beijing and California recreate the moa that once roamed New Zealand forests, these de-moa will not be a creation of the same kind as the moa produced through evolution (Iorns). These creatures will have been produced through a process unlike evolution, in a radically different an environment, with differing epigenetic conditions and bacterial symbionts.[3] In this way, they will resemble reproductions of artworks. Recreated versions of species that became extinct decades or centuries ago are, in this sense, reproductions.[4]

Even though species recreated through de-extinction are reproductions, their recreation may have advantages. Reproductions of artworks do not have the same value as originals, but it does not follow that reproductions are valueless or even that they have less value than original artworks. Reproductions of artworks enrich people's lives and encourage people to learn more about art, artists and history. If this were not the case, presumably authors Martin Bailey, Laurence Anholt, and James Mayhew among others, would not include reproductions of Van Gogh's Sunflowers in their books, and prints of Van Gogh's Sunflowers would not be sold in art galleries. Reproductions of extinct species may also enrich people's lives and encourage people to learn more about flora and fauna, ecological systems and environmental ethics.

For those who value the tie to evolution, de-moa will be as much a reminder of what can be lost through a failure to value and protect organisms, species and ecological systems as they are a reminder of human ingenuity, values and hard work. To the extent that people care about such losses, de-moa could thus serve as a reminder to think before acting in ways that may be destructive. Thus, any perceived unnaturalness stemming from a break in the evolutionary chain between extinct organisms and their de-counterparts may be compensated for by a reduction in future extinctions due to increased care for the environment.

7.2 Fear of Harm from Frankensteinian Creations

The unnaturalness objection may be partly grounded in a concern that the process of de-extinction will violate the integrity of the organisms or ecological systems in a way that accidentally destroys the environment. Chapman, for example, suggests that '[unnaturalness is] a

way of talking about radical uncertainty, or ignorance about the effects of a new technology'. The history of extinction includes many cases where human intervention destroyed a species (Diamond, Ashmole and Purves). This has occurred even when the goal of the intervention was to improve the environment. The New Zealand Acclimatisation Society's work in the nineteenth century was intended to increase diversity, not threaten native species (Druett 88-96). People quickly realised that good intentions and enthusiasm coupled with ignorance can lead to bad consequences:

> 'It is a matter for regret,' said Mr Bathgate to the Otago Institute in 1897, 'that the zeal of the earlier acclimatisers was greater than their knowledge, and that mistakes were made by them fraught with evil results of a far-reaching and permanent nature. Due care and consideration,' he protested, 'would have prevented the introduction of several undesirable immigrants, which now, like the poor, are always with us.' 'It is time drastic steps,' said Mr Poppelwell to the New Zealand Science Congress in 1929, 'were taken to cope with the evil being done to our fauna and flora by foreign importations.' (Druett 99)

Undoing harms caused by releasing a new species into an environment is much harder than releasing them. Even with careful research, the consequences of releasing de-species into the environment will be uncertain.

Placing de-animals in settings other than zoos or quarantined reserves will need to be done with extreme caution. Given the risks associated with introducing new species into an environment, the decision about whether to recreate a lost species should be based on well-reasoned expectations that recreating the species will be of value, whether to humans, other non-human animals, existing species or ecological systems. Knowledge and protocols from the development and spread of biological controls and genetically modified organisms can be used to limit harm from organisms produced through de-extinction. We already know some things about the likelihood that various species of flora and fauna will undermine certain ecological systems. Objections based on a fear from unnatural creations have merit, but with care risks can be mitigated.

7.3 Unnatural Actions and Power Relations

Technologically intense processes tend to increase the autonomy of some people, but decrease the autonomy of others (Chapman; Lewis 718-30). As C.S. Lewis writes, 'what we call Man's power over Nature turns out to be a power exercised by some men over other men with Nature as its instrument' (719). Thus, concern about naturalness dovetails with concern about justice. No current regulations or codes compel, or even encourage, those working on de-extinction projects to act in ways that consider the good of communities affected by their actions. This will not be an issue for de-extinction projects on flora and fauna that have been extinct for millennia, because no living cultural group will have close ties to such species. However, it will be an issue for some species that recently became extinct. For example, the de-extinction of moa is being pursued outside of New Zealand without any involvement of Maori who have the closest cultural ties to moa (Iorns). Ignoring the relationship between communities with cultural ties to certain flora and fauna is a problem that occurs in other areas, such as captive breeding programs. Animal breeding advocates, institutions and environmental agencies often fail to mention this issue, but this does not make it less important.[5]

If this matters, and surely it does, there are ways of ensuring that cultural ties to flora and fauna are recognised by de-extinction projects. On one sense of the word 'natural', working at a more natural level would involve working in locations where the species originated and where similar species still exist. For example, if the de-extinction of Australian animals like the Tasmanian Tiger is based in Southern Australia, this will make it easier to involve local Aboriginal communities in the project. Although consultation may occur voluntarily, ethical de-extinction is likely to require codes or regulations to ensure that it proceeds in a way that respects the cultural interests of those with ties to particular species. State level policies that facilitate the involvement of those with a cultural connection to the species are likely to be needed. International regulations will also need to be instituted to control de-extinction programmes for flora and fauna endemic to one country in different countries. Such regulations will be particularly important to support indigenous people in colonised countries, who are

likely to already have reduced autonomy, and indigenous people in developing countries, where the socio-economic situation may weaken their ability to control the treatment of valued local flora and fauna.

8. Conclusion

Objections based on the unnaturalness of a proposed action or consequence cannot always be dismissed on the grounds that they rely on an assumption that everything that is unnatural is bad. Deontological arguments can use a thick concept of 'natural' to avoid the naturalistic fallacy. Consequentialists can avoid the naturalistic fallacy by demonstrating that certain consequences are bad. However, none of the arguments against de-extinction discussed here demonstrate that the various ways in which de-extinction or de-extinction processes are unnatural give good reason to prohibit de-extinction.

At its most convincing, the unnaturalness objection to de-extinction provides a prima facie objection to de-extinction. Introducing what will, in a sense, be new species into an environment is risky, and those who control technologies that manipulate nature can harm those with less technological power whose wellbeing is tied to nature. Whether these objections demonstrate that the pursuit of de-extinction should be halted or limited will depend on whether these concerns are outweighed by benefits from de-extinction or can be dealt with by modifying or limiting the ways in which de-extinction is pursued. For the de-extinction of any species to be ethical, it is important that researchers consider the ways in which de-extinction practices may destroy existing ecological systems or species or harm cultural relationships with nature, together with the welfare of members of the de-species.

Notes

[1] See Douglas Campbell (2016) for an argument that the importance of this difference has been exaggerated.

[2] Similarly, international organisations' statements about non-therapeutic genetic modification in humans suggest that there are prima facie reasons not to carry out genetic modification. Such statements have preserving or respecting human dignity as a central aim, and conclude that genetic engineering of humans is only acceptable for reducing suffering or for therapeutic purposes. That is, genetic modification has disvalue because it undermines dignity, but is justifiable when it reduces harms not readily treated in other ways. See, for example, UNESCO's Universal Declaration on the Human Genome and Human Rights and the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine.

[3] Symbiotic bacteria evolve alongside their hosts and, among other things, are known to protect organisms against a variety of threats, affect the way that animals digest food, and affect chemical signals, including reproductive signalling, in some organisms (Goodwin et al.; Dubilier, Bergin and Lott; Sachs, Skophammer and Regus; Lundgren and Lehman; Flórez et al.).

[4] Cf Douglas Campbell in this volume.

[5] Webpages for captive breeding programs tend not to mention cultural groups with ties to the animals bred in zoos. However, there are exceptions. Concern for human-animal relationships among indigenous people is shown in work by institutions, such as the CSIRO in Australia (Burbidge, Woinarski and Harrison), and work by individuals, such as white lion conservationist Linda Tucker (Tucker and Harvey).

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