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RESURRECTING EXTINCT SPECIES

Ethics and Authenticity

**Douglas Ian Campbell and
Patrick Michael Whittle**



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Dedication

From Doug—for Zoe, Isla, Nelly and Lucia.

From Mick—for Sue and Poppy.

PREFACE

Momentous things are afoot in laboratories around the world. DNA, extracted from the bones of extinct animals, is being put into sequencing machines, and the long-lost genetic blueprints of extinct species are being pieced together by computers. Synthetic copies of extinct animals' genes are being inserted into the chromosomes of living cells. Such modified cells are being turned into full grown, transgenic organisms by cloning. Doctor Frankenstein himself would be impressed.

The technology for bringing back extinct species is now a reality. It is growing more powerful day by day, for in the field of synthetic biology, what was science fiction one year is often humdrum, routine procedure only a few years later. Of course, the technology has certain fundamental limits. The *Tyrannosaurus rex* of *Jurassic Park* fame will never tread the Earth again, any remaining traces of its DNA having been bombarded to smithereens by cosmic radiation long ago. 'All the king's horses and all the king's men will not put the T. rex together again'—a fact that will be a matter of eternal regret to generations of schoolchildren down the centuries to come. But the news for schoolchildren is not all bad. DNA's half-life in permafrost is very long, which puts the woolly mammoth in firm contention as a de-extinction candidate.

From a philosopher's perspective, de-extinction is a delightfully controversial subject. The questions it raises are immense, important, and difficult. They go to the heart of much more general philosophical problems. What is a species? Why should we value biodiversity? Do we have a moral duty to undo harm that our species has done to other species? Does moral

wisdom militate against our using technology to manage and control the non-human world?

Given the pace of technological progress, a book on the philosophy of de-extinction is urgently needed. And here it is! We hope the book will be useful. We believe it contains some good ideas. We are acutely conscious that it is not perfect. We hope we have not said too many unwise things, or criticized others views too unkindly or unfairly.

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Conservation in a Brave New World

Abstract This chapter introduces the two main philosophical questions that are raised by the prospect of extinct species being brought back from the dead—namely, the ‘Authenticity Question’ and the ‘Ethical Question’. It distinguishes different types of de-extinction, and different methods by which de-extinction can be accomplished. Finally, it examines the aims of wildlife conservation with a view to whether they are compatible with de-extinction, or not.

Keywords De-extinction • Conservation • Authenticity • Ethics

1.1 THE LAST BUCARDO (OR NOT?)

In January 2000, a storm in Spain’s Ordesa National Park caused a tree bough to snap and fall. Sheltering beneath the tree was an animal named ‘Celia’, the last Pyrenean ibex, or ‘bucardo’, left on Earth. Mortally injured, Celia breathed her last breath—and with that the goat-like bucardo, long persecuted by hunters, was extinct.

This, however, was not to be the last breath of an animal with bucardo DNA.

Months before Celia died, a sample of skin had been snipped from her ear and preserved in liquid nitrogen. In October 2000, a team of reproductive physiologists set to work on Celia’s cryogenically preserved cells, applying the techniques that had been used in 1996 to clone ‘Dolly’, the

sheep. They extracted living nuclei from some of the cells, and substituted these for the nuclei in fertilized goat ova. Dozens of such modified ova were implanted into female goats, of which seven became pregnant. Six of these goats miscarried, but one reached term. On July 30, 2003, a female kid was obtained by caesarean section from this surrogate mother. A DNA test later confirmed it to be Celia's clone (Folch et al., 2009).

Unfortunately, a lung abnormality (a common complaint in clones) caused the bucardo kid severe respiratory distress and, after a few strangled breaths, it died—just seven minutes after being born. Still, it did manage some strangled breaths. As a result, the bucardo now, arguably, has the dubious distinction of being the first animal ever to go extinct *twice*—first in 2000 when Celia was crushed by the falling branch, and then a second time, in 2003, when her clone expired.

A *de-extinction* is the reversal, or undoing, of an extinction. The concept needs little introduction thanks to Hollywood's 1993 blockbuster, *Jurassic Park*—a cautionary tale of resurrected dinosaurs running amok and killing the hubristic scientists who created them. When *Jurassic Park* first hit the movie screens de-extinction was still the stuff of science fiction, but the technology has since advanced in leaps and bounds. The 1990s witnessed the advent of mammalian cloning, and high-speed, inexpensive genome sequencing came of age in the 2000s. The 2010s are the decade of CRISPR, a game-changing gene editing technology that allows genetic engineers to cut and paste genes into chromosomes virtually at will. Biotechnology is now developing at an exponential rate, and the implications for medicine, agriculture and human society at large could hardly be more profound. So too are the implications for wildlife conservation. As the technological obstacles to de-extinction have tumbled, multiple de-extinction projects have been announced around the world, including attempts to resurrect the aurochs, the woolly mammoth, and the passenger pigeon—three species that will be the focus of Chap. 2.

The wheels of biotech spin fast. Those of philosophy turn rather more sedately. Now that 'the bucardo is out of the bag' (as it were), philosophers have an urgent game of catch-up to play. De-extinction throws up a host of controversial and important philosophical questions, the foremost of which are these:

- *The Authenticity Question.* Can de-extinction technology be used to genuinely reverse the extinction of a species, by boosting its population size from zero to a higher number?
- *The Ethical Question.* Should conservationists judge de-extinction to be ethical? (That is, should they embrace it, or not?)

This book is about the philosophy of de-extinction in general, and the answers to these two questions in particular.

1.2 THE AUTHENTICITY QUESTION

Which animal was the last bucardo to live and breathe? Was it Celia? Or was it her clone? The answer depends on what Celia's clone *was*. Was it an authentic bucardo, like Celia, or was it something else—a Frankenstein creation, an animal of a new and unnatural type?

Here is one way of understanding the relationship between Celia and her clone. Since they shared identical chromosomes they were in effect identical (monozygotic) twins, albeit twins born to different mothers far apart in time. If we think of Celia's clone in this way—as being Celia's belatedly born identical twin—then it follows that the clone was itself a bucardo, just like Celia. The last bucardo to live and breathe, therefore, was Celia's clone, not Celia.

But there is a second possibility. Celia's clone differed from Celia in at least two potentially important ways. First, the clone was not quite a perfect genetic copy of Celia. While the clone did have the same nuclear DNA (i.e., the same chromosomes) as Celia, its mitochondria came from a surrogate mother (a goat) who donated the ovum from which the clone grew, not from Celia, who contributed only the nucleus. Therefore, the clone's mitochondrial genes were goat genes, not bucardo genes. Second, Celia's clone differed from Celia with respect to her *history* and *mode of genesis*. Celia was a natural organism—the product of aeons of life, death and differential reproductive success among the bucardo of prehistoric Europe. Celia's clone, in contrast, owed her origins to a team of white-coated synthetic biologists working with machines and chemicals in a biotech lab. For either or both of these reasons—or perhaps for some other reason—we might conclude that Celia's clone was not an authentic bucardo, and that she was instead a member of some new, artificial, synthetic species, a mere 'pseudo bucardo' as it were.

If this second way of thinking about Celia's clone is correct then the bucardo did not go extinct *twice*. It instead went extinct *just once*, when Celia met her unfortunate end. Because it wasn't truly resurrected when Celia's clone was created, it was never in a position to go extinct a second time. On this way of understanding events, Celia was the very last of her species. Her clone was the first (and perhaps the last) of a new, different, artificial breed of animal.

Here, we can distinguish *authentic de-extinctions* from *pseudo de-extinctions*.

Authentic de-extinction: increasing an extinct species' total population size from zero to some higher number, by creating new, living organisms that are authentic members of the same species.

Pseudo de-extinction: leaving an extinct species' total population size at zero, so that the species is still extinct, but creating organisms that resemble the extinct organisms closely enough to be easily mistaken for them, even though they are in fact members of a wholly new, synthetic 'race' of organisms.

In other words, an authentic de-extinction involves the true 'reversal' or 'undoing' of an extinction event, while a pseudo de-extinction does not. The products of an authentic de-extinction are the genuine articles or the real McCoys, while the products of a pseudo de-extinction are mere lookalikes, or fakes, or shams, or proxies, or facsimiles, or simulacra. A pseudo de-extinction is very much a low-grade or poor man's de-extinction. That said, a pseudo de-extinction might still be of considerable value from the conservationist perspective. For example, pseudo de-extinct organisms might be able to act as ecological proxies or surrogates for the extinct organisms they are based on, by performing important ecological functions the extinct organisms used to perform.

If authentic de-extinctions are possible then the answer to the Authenticity Question is affirmative. If pseudo de-extinctions are the best that is possible, then the answer is negative. We will give the name 'authenticism' to the doctrine that authentic de-extinctions are possible and that the answer to the Authenticity Question is affirmative. Thus an *authenticist* is someone who thinks authentic de-extinctions are possible, while an *anti-authenticist* is someone who denies this.

To see why it matters who is right—the authenticist or the anti-authenticist—consider the system used by the IUCN Red List for ranking species by conservation status. It involves assigning species to the following categories (IUCN, 2017):

Least concern
Near threatened

Vulnerable
 Endangered
 Critically endangered
 Extinct in the wild
 Extinct

If authentic de-extinctions are possible, then a new category will need to be added to the bottom of this list, namely:

Terminally extinct

If a species is extinct, yet still salvageable because it is amenable to authentic de-extinction, then it will not be terminally extinct. Rather, it will be in a kind of limbo from which biotechnology can summon it back. On the other hand, if an extinct species cannot be made authentically de-extinct—say, because any last vestiges of its DNA have long since degraded to gibberish—then it will be terminally extinct rather than merely extinct. Of course, if authentic de-extinctions are impossible—if anti-authenticists are correct and the answer to the Authenticity Question is negative—then all extinctions are terminal. There will, in this case, be no limbo betwixt life and death for a species to go into, and the old conservationist rallying cry that “Extinction is forever!” will express an iron rule with no exceptions.

The assumption that extinction is forever has long been taken as axiomatic by environmentalists. The philosopher, Holmes Rolston III, expresses the thought by equating extinction with a “superkilling”:

It kills forms (species) beyond individuals. ... It kills birth as well as death. Afterward nothing of that kind either lives or dies Life on Earth cannot exist without its individuals, but a lost individual is always reproducible; a lost species is never reproducible. (1991, p. 85)

In a similar vein, the naturalist, Peter Matthiessen (1959) spoke of extinction’s “awesome finality”.

If this widespread assumption is false—if authenticism is true and extinctions need not be forever—then conservationism’s priorities will need to be rethought. Most obviously, if a species has already gone extinct but is not yet terminally extinct, we will need to ask ourselves whether we have mourned it prematurely or whether it is worth spending precious

conservation resources trying to recover it. A less obvious (but probably more important) implication of authenticity's being true is how we should deal with *future extinctions*. All indications are that the surge of anthropogenic extinctions the Earth has witnessed so far is but the harbinger of a much larger Holocene mass extinction still to come. Irreversible planet-wide changes that have already been set in motion by our species—to the climate, to sea-levels, to the ocean's pH, to the distribution of species—are set to have calamitous effects over coming decades and centuries. As this mass-extinction event gathers force, conservationists will be overwhelmed. (Indeed, they are overwhelmed already.) Intensive triaging will be necessary, with desperate decisions having to be made as to which species to save and which to let slip away.

Rather than simply letting a species slip away forever, another possibility would be to let it undergo a 'managed extinction' by cryogenically preserving as many of its cell-lines as possible. By this means conservationists could, in those cases where they cannot save a species, at least prepare the ground to bring it back in future, if and when it becomes possible to do so. Conservationists living centuries hence, with technological capacities exponentially greater than ours, could be very grateful to us for our foresight if we were to put the Earth's lost biodiversity 'on ice' in this way. While it might seem strange to base what we do now on speculation about what people will be capable of in the distant future, such centuries-long timeframes—being the timeframes over which large trees grow—are very much part-and-parcel of ordinary conservationist thinking and planning.

De-extinction could be of huge value as a conservationist tool in the very long-term, by providing our species with a way of recovering some precious fraction of the biodiversity that will be lost to the coming mass-extinction event. But this assumes that authenticity is true—i.e., that de-extinction truly offers a way of *recovering lost biodiversity*, as opposed to *creating artificial biodiversity*. If authenticity is false then most of de-extinction's apparent promise as a tool for conservation is fraudulent. De-extinction has many anti-authenticist critics who have made this point in no uncertain terms. For example, Blockstein (2017) scathingly remarks that “one of the ethical violations of the proponents of ‘de-extinction’ is to lure and seduce the public with false promises ... of bringing extinct species back from the grave”. Switek (2013) writes that “‘revive and restore’ projects are actually creating new species rather than truly resurrecting what was lost”. And Minter (2015) says that “de-extinction proponents too casually and uncritically equate ... engineered doppelgängers with ... vanished species”.