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## De-extinction: raising the dead and a number of important questions

I suspect that I am like most of you who have read the recent flood of articles about de-extinction—both in awe of the possibility of bringing back extinct species that formerly roamed the Earth, as well as cautious about the potential pitfalls of this new plan. In many ways, it should come as no shock that we, the scientific community, are likely to share this optimism and caution about a controversial topic. It's how we think on a daily basis. We are taught to ask questions, and seek out novel solutions, but we are also taught to be circumspect, measured, and to utilize the precautionary principle in most situations.

In the case of de-extinction, it is clear that the scientific research that underpins this new field is some of the most exciting we've ever seen. Over the last decade, de-extinction researchers have initiated the first efforts to sequence and reconstruct genomes of extinct taxa (e.g., woolly mammoth, passenger pigeon; Miller et al. 2008, Hung et al. 2013, LongNow<sup>1</sup>). In addition, scientists working on de-extinction have made advances in selective breeding that can essentially reverse-engineer organisms and reduce the number of domesticated traits in an animal (e.g., selectively breeding cattle to resemble ancient Aurochs; Faris et al. 2010, Switech 2013). Finally, substantial advances are being made in developmental biology and cloning as scientists search for suitable hosts in which a genetically engineered fetus can persist (Cottrell et al. 2014).

Collectively, these lines of research represent cutting-edge projects that are logical and novel extensions for where each of these sub-disciplines is heading. However, advances in these fields that have expanded the possibility that researchers will actually achieve the goal of de-extinction have raised important ecological and ethical questions (Sandler 2013, Cottrell et al. 2014). Perhaps most importantly, this expansion into de-extinction science has led to the question,

regardless of whether we can bring back species from extinction: is this something we should actually pursue? Predictably, trying to answer this question has only led to the development of more questions, including whether it is our responsibility to restore species driven to extinction by humans (Jørgensen 2013, Sandler 2013), and what the concept of 'natural' really means if we're engineering organisms and raising them from the dead (Sandler 2013).

A second interesting point about the advancement of de-extinction has been that the debate over these questions has not occurred primarily within the scientific community. Instead, the debates and discourse over this topic have seemingly been playing out in the international media and in public forums (Seddon et al. 2014). In 2013, it wasn't *Science* or *Nature* that led the preliminary discussions that introduced these topics to the world. It was instead *National Geographic* and Revive & Restore (a branch of the Long Now Foundation) that created TedxDExtinction<sup>2</sup>, a TED-supported program about the pros and cons of de-extinction. This exciting program, which garnered international headlines, was a major driver in pushing this field to the forefront of conservation science. Just how far we've come is evident from the fact that an article about de-extinction, entitled "The Mammoth Cometh", was released as the cover story for the *New York Times Magazine* in February (Rich 2014).

In this issue of *Frontiers of Biogeography*, we invited two expert scientists (Dr Kate Jones and Dr Josh Donlan) to discuss the pros and cons of de-extinction and give their measured scientific opinion about the validity of this conservation approach. What is interesting about these two pieces is that, despite the fact that the authors have differing perspectives about how and why we should utilize this technology, they both acknowledge that it is moving forward and will be a

1 <http://longnow.org/revive/what-we-do/passenger-pigeon/> (last accessed 10<sup>th</sup> March 2014)

2 <http://tedxdeextinction.org> (last accessed 10<sup>th</sup> March 2014)

part of the conservation landscape in the future.

As a conservation scientist, I find myself often attempting to balance crazy and provocative ideas with a circumspect scientific approach. In the case of de-extinction, however, I find myself agreeing with Jones and Donlan—that debate is still ongoing about the ultimate purpose and goals of this field, but the reality is that the framework and foundational science are here and it is only a matter of time before the first successful de-extinction happens.

Where does this leave us as we stop and think about de-extinction science? I argue that we, the scientific community, have an important remaining task. As these conversations continue to spill over into the public forums and become increasingly debated by individuals in the general public, it will be our job to provide people with a measured and objective view of what the implications of utilizing this technology are. The truth is that, despite the fact that we may not be able to stall or prevent the advancement of this field, we, the scientific community, have the responsibility to utilize our theoretical and empirical understandings of the world to offer insights about the potential implications of de-extinction.

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