



Cloning the Extinct: Restoration as Ecological Prostheses

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On the whole, the conservation biology community doesn't support the use of cloning to return extinct species to life, but there are persuasive philosophical and practical reasons for giving the idea another hearing. To begin with, there's little reason to fear *Jurassic Park*-type scenarios. The idea that dinosaur DNA could be extracted from amber-trapped mosquitoes stretches probability beyond the breaking point in the interests of good storytelling (Austin et al. 1997; Holden 1997). Numerous studies suggest that DNA probably can't last in most geological environments for much more than 10,000 years and almost certainly not beyond 100,000 years (Pääbo and Wilson 1991; Lindahl 1993, 1997; Austin et al. 1997; Poinar et al. 1996; Bada et al. 1999). Since dinosaurs died out roughly 65 million years ago, restoring any of them is pretty much out of the question—but isolating DNA that's on the order of 10,000-15,000 years old might rule in the possibility of cloning Pleistocene species for restoration. Even that wouldn't be easy. In the case of woolly mammoths found frozen in permafrost—which are among the best preserved specimens of extinct Pleistocene fauna—only short strands of mitochondrial DNA have been recovered—not the nuclear DNA that would be necessary for cloning (Lindahl 1999). Some Pleistocene nuclear DNA has been found, but there's not very much of it and it's not easy to isolate (Greenwood et al. 1999, Hofreiter et al. 2001). What all of this means is that biotechnology's potential for restoring extinct species will be far more modest than the general public might suspect—unless the biotech industry experiences some truly radical technological innovations or someone discovers some as yet unanticipated sort of micro-environment that's ideally suited to preserving fossil DNA.

The prospects for cloning other extinct species, however, are far better—particularly for species that have recently disappeared. Species for which museum specimens exist offer particularly good opportu-

nities, especially those such as the thylacine (a marsupial also sometimes called the Tasmanian wolf), some of which are stored in alcohol, an excellent DNA preservative. Nonetheless, the Australian Museum's ongoing effort to clone the thylacine faces significant technical hurdles (Weidensaul 2002). Given the potential for biotechnology to influence future conservation and restoration practices, however, it behooves us to consider now the ethics that will guide those decisions. The cautious application of cloning technology to extinct species restoration could one day prove to be an important conservation tool. Accordingly, the technology merits at least minimal support.

Objections and Supports

For very good reasons, many conservation biologists object to supporting experimental technologies when there is a pressing need for funding more reliable approaches to conservation (e.g., Rabinowitz 1995; Hunter 1996; Salsberg 2000; Hunter 2002). If there is only so much money, labor, or any other resources available, diverting it from demonstrated methods toward cloning could be disastrous. It's worth remembering that conservation biology is a crisis-driven discipline. Cloning might allow humans to restore one extinct species, but by diverting resources that could have been used to protect habitat, two or more other species might end up being lost. At that rate, conservationists would never catch up.

As the most experimental and uncertain form of biological restoration, cloning is subject to more pronounced versions of the objection to which restoration in general is prone: It's better not to break things in the first place than it is to fix them once they're broken. In discussing restoration in general, Malcolm Hunter (2002: 375, 308) notes, "for a given level of effort, the impact of a protection project will usually be greater than the impact of a restoration project" and, "The real

or perceived opportunity for restoration can make it easier to justify additional ecosystem degradation.” In addressing cloning, however, Hunter (2002: 356) notes more forcefully that, “When reading the popular press, one sometimes gets the impression that with the advent of cloning and other genetic techniques we can relax a bit in our struggle to save the giant panda and other species, but this prospect shows a stunning ignorance of ecological realities.” The suggestion that “the cloning of endangered [or extinct] species is as far removed from the spirit and psychology of conservation as we’ve ever been since man first noticed he was killing off the birds and beasts” (Tait 2001: 46) is one especially strong formulation of the anti-cloning position. However, the objection that cloning could lead humans to view more conventional sorts of conservation as unnecessary, while understandably cautious, is probably unwarranted.

First of all, it’s not entirely clear that there is a fixed resource pool on which conservation efforts must rely. In fact, by supporting the use of cloning in species restoration, new funding for conservation efforts might become apparent. Partial financing for a project to clone New Zealand’s huia, a bird driven to extinction in the nineteenth and early twentieth centuries, was provided by cyberuni.org, inc., a California Internet startup corporation (“Cloning” 1999), while the Australian Museum’s efforts to clone the thylacine are being partially underwritten not only by the government of New South Wales but also by a private trust created specifically for the purpose (Weidensaul 2002). Cloning, then, has not necessarily been the drain on conventional conservation funding that some opponents have feared. Moreover, it might never become one. Possibly, the opposite is true: the use of novel technologies and techniques might actually provide a net gain of resources by attracting the attention of individuals and organizations that would not otherwise have supported conservation.

Since habitat degradation and loss are so often implicated in extinctions, there is a high likelihood that the cloning of extinct species for reintroduction to the wild could not even commence until a major shift had already occurred in human attitudes and behaviors. For instance, there is no particularly compelling reason to clone the passenger pigeon if there’s not enough habitat to support the species. Minimal support for cloning could begin to allow the conservation community to work toward a passenger-pigeon-type project, however. At the same time, the development of necessary precursor technologies for the cloning of extinct species could enhance current conservation efforts, leading, for

instance, to the creation of procedures and technologies that would have applications in the management of endangered species subject to severe inbreeding. In addition, efforts directed at cloning could have a positive effect on public opinion that critics have not considered. Rather than leading to environmental irresponsibility, progress on the cloning front could bolster the morale of conservation-minded individuals by showing that at least some of humanity’s environmental errors can be corrected. Thus far, and it is very early in the process, the cloning of the huia could be a case in point (“Cloning” 1999). Rather than diverting attention from environmental problems, the cloning of extinct species could galvanize public opinion in such a way as to make broader conservation goals easier to achieve.

The Ethical Spectrum: Genuineness, Artificiality, and Choosing the Right Course of Action

Aldo Leopold famously asserted that “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” (1949: 224-225) —a position that, although objectionable to some ethicists for reasons ably explained by J. Baird Callicott (1987), has relevance here. Leopold’s land ethic, which extends the ethical protections traditionally reserved for individual human beings to biological communities, suggests a viable and compelling option to the anthropocentric arguments that might otherwise tend to drive cloning efforts. More specifically, decisions to clone extinct species that are motivated primarily by human desire will not withstand the same level of scrutiny as those motivated by a desire to restore biotic communities.

Human responsibility for numerous extinctions in historical times is clear. Contemporary conservation practice also recognizes that the environmental damage humans cause should be corrected to whatever extent is practical, a perspective on mitigation-restoration which recognizes that the righting of some past ecological misdeeds is an ethical decision very much in keeping with Leopold’s declarations about what constitutes right and wrong behavior. Yet the cloning of extinct species to return them to the wild clearly raises new questions for restoration biology. For instance: If we isolate sufficient DNA to recreate an extinct species and then do so, is the resulting species genuine? Imagine, for example, that we isolated DNA from museum specimens of passenger pigeons, cloned the species (hatching the young from the eggs of extant relatives), and, finally, that we made sure that these clones had adequate habitat, formed viable flocks, were

capable of migrating, and could reproduce without fear of inbreeding. Imagine, in short, that humans restored to North America a species it removed in the nineteenth and early twentieth centuries.

Certainly, the newly restored passenger pigeons would be a “real” component of the ecosystems they occupied in the sense that they would participate in nutrient cycling, function as prey for some species, compete for resources with others, and, more generally, occupy a niche and perform a variety of ecological roles. At the same time, due to the conditions of their original loss and restoration to North America, they would undeniably also be an artificial replacement—at least initially—for the missing species that previously occupied the continent. In a sense, any reintroduced, recreated species would be a sort of ecological artificial limb or prosthesis provided by humans to replace the amputated original. Such a metaphor provides a useful means of examining a variety of relevant issues. For one, the prosthesis metaphor leads us to consider that the quality of the replacement in duplicating the missing original would likely be a key consideration in determining whether or not its restoration would be an ethical course of action. A pair of hypothetical examples clarifies the point.

If a person were to lose a limb but was fortunate enough to have it replaced by an artificial limb so much like the original—one that worked and felt and seemed so exactly like it—that she could not tell the difference, concern about the “genuineness” of the replacement limb might reasonably be seen as irrelevant. Alternately, a less faithful simulation that left the user unable to overlook the replacement limb’s artificiality would necessarily invite unfavorable comparisons with the missing original, thereby raising concerns about genuineness. Here, then, is the question: If we end up with a restored species that is better than nothing but far short of what it replaced (the ecological equivalent of the peg legs that pirates are always depicted as hobbling around on, say), are we more justified in calling the replacement artificial, and, alternately, if the replacement is indistinguishable from the original, are we less justified in viewing it as artificial? Answering such a question is difficult, but ecosystems, like people, are arguably far better off with prosthetics, particularly high quality prosthetics, than without them.

Conclusion

Given the obvious limitations of the human perspective, it would be shortsighted not to attempt to both protect what remains of global biodiversity and

restore what we can of what was lost due to human actions. Such restoration is, in both principle and practice, consistent with mitigation. Hunter (2002: 304–305) articulates a truism of conservation biology in observing that it is always preferable to avoid an impact so as to make mitigation unnecessary, but, “if the impact cannot be avoided, the site should be restored, or at least rehabilitated, after the impact is over.” From a contemporary perspective, the loss of species that resulted from the action or inaction of previous human generations would certainly qualify as unavoidable impacts; if and when the human species gets to a point where the planet’s many ecosystems have been restored sufficiently to support extinct species, it would be consistent with the tenets of conservation biology to consider restoring those species on a case-by-case basis. Cloning could provide the means to not only correct specific past mistakes but also the opportunity to demonstrate to a too-often dispirited public that it is still within our power to repair some of what we have so carelessly broken.

Cloning technologies should not be developed to the detriment of conventional modes of conservation, however. Nonetheless, to simply rule out all investment of resources in conservation-oriented cloning is shortsighted. To do so would remove too valuable a potential tool from the conservation toolbox—particularly since the benefits of cloning are liable not to be limited to the end goals of cloning extinct species. While projects seeking to clone the huia or thylacine move toward their stated goals, they are liable to develop technologies and procedures with immediate applications for managing endangered species and restoring species to former portions of their ranges. Rather than ruling out cloning, conservation biologists should offer it cautious support as part of a broad, multifaceted plan to protect biodiversity. Doing so would give the conservation community a voice in decision making about the use of an emerging technology, perhaps giving conservationists their best available opportunity to avoid a situation in which cloning efforts are driven by market forces without regard to the technology’s consequences for global ecosystems.

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