

Reintroduction and De-extinction

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We are entering an age in which species extinction may be reversible. *De-extinction*, as it has been labeled, can apply to any species for which DNA can be recovered, from woolly mammoths of the Pleistocene to thylacines and passenger pigeons from the twentieth century. These developments, which were showcased in March 2013 at a daylong conference called TEDxDe-Extinction, held in Washington, DC, (<http://tedxdeextinction.org>), are exciting to some scientists and terrifying to others. If we are to embark on this de-extinction journey, an act some might label *playing God*, we need to establish the rules of the game. I want to suggest that the well-established standards for species reintroduction projects provide a solid foundation on which de-extinction can be built.

Critics of de-extinction in the popular science media have quickly pointed out drawbacks. From an ethical perspective, they have pointed to potential violations of animal welfare standards, the potential drain on resources that could be used in the conservation of still-existing species, and the implication that species destruction might be seen as permissible if it is reversible. The ecological objections have included the lack of ecosystems in which the re-created creatures could live, the potential invasiveness of the species in the ecosystem, and the potential for new disease vectors. Exploration of de-extinction's ethical dilemmas will require serious scientific and public debate, including a significant contribution from humanities researchers, including philosophers and historians, who have the appropriate theoretical background for conceptualizing what is at stake. I will not tackle those ethical issues here. The solution to the ecological dilemmas, however, may already be at hand

through the application of reintroduction standards.

Reintroduction as a guide

Reintroduction, the release of a species into an area in which it had been indigenous but has since become extinct, is a long-standing practice. The earliest use of the word *reintroduction* in a conservation context is in an article from 1832 about the return of capercaillie (or *capercailzie*) to Scotland (Wilson 1832). The western capercaillie was hunted out in Scotland in the late eighteenth century, and Wilson reported on the first attempt to bring the birds back to Scotland using specimens from Sweden. From these humble beginnings, an entire science of reintroduction has been built up, particularly over the last 30 years.

Reintroduction science has a strong institutional basis in the International Union for Conservation of Nature (IUCN) and in its Species Survival Commission reintroduction specialist group, founded in 1988. The IUCN developed guidelines for reintroduction (IUCN 1998), which are currently under revision (Dalrymple and Moehrenschrager 2013). The guidelines suggest background studies to allow identification of the species' habitat requirements, identification of lessons learned from prior reintroduction projects of similar species, evaluation of potential sites within the former range of the species, selection of appropriately diverse genetic stock, and an assessment of the socioeconomic context of the project. Armstrong and Seddon (2008) extended the guidelines, proposing key questions at the population, metapopulation, and ecosystem levels that should be addressed before reintroduction proceeds.

Because the natural extension of de-extinction is the reintroduction of

the species to the wild, at a minimum, the species should be targeted for de-extinction only if the original causes of extinction are removed and the habitat requirements of the species are satisfied. Scientific background studies, including the assessment of the socioeconomic aspects of the project, should be undertaken before the technical work on re-creating the species. If the species has nowhere to go, de-extinction should not move forward.

Even before a newly nonextinct species is ready for release, guidelines exist for how it should be handled. From the moment they are born, the animals would be classified as *extinct in the wild* according to the IUCN Red List standards. As such, they should be managed within the guidelines for existing species recovery and conservation paradigms with a focus on captive breeding (IUCN 2002). This would, of course, be crucial in order to build up a viable population of the species. Lessons learned from existing programs for recovery of formerly *extinct in the wild* species, including the California condor, the Arabian oryx, and the European bison, should be incorporated into the management strategies of resurrected species.

Potential reintroduction conflicts

Reintroductions of recently extirpated species tend to be relatively uncontested, but when the species have been absent for a long time, applying the *reintroduction* label can be more contentious. Reintroduction plans for species that have been absent for hundreds or thousands of years, such as the beaver and the lynx in Scotland, have stirred up opposition from landholders and special interest groups, who think of these animals as invaders and intruders. Even within scientific circles, the *reintroduction* label has not

always been accepted for species absent for an extended period. For example, the Norwegian Black List of invasive species specifically includes musk ox and wild boar present in the country as illegitimate reintroductions, even though the species are known to have existed there thousands of years ago.

Human acceptance of reintroduction projects will be a crucial aspect to consider for de-extinction. Reintroducing brooding frogs, which died out only in the 1980s, will probably be uncontested, because of their recent extinction history. Reintroducing the thylacine, which was hunted to extinction by the 1930s, may prove unproblematic from a species-history standpoint, although it may be rejected by locals because the species is a carnivore, similar to wolf reintroduction plans in North America and Europe. The woolly mammoth, however, will likely invoke a huge opposition based on the thousands of years it has been absent

from Earth. We should all remember the significant outcry against the Pleistocene rewilding scheme of Donlan and colleagues (2005); this time, the proposal would be with real mammoths instead of surrogate elephants.

In spite of these conflicts, *reintroduction* is an appropriate label, regardless of the length of time the species has been absent (Jørgensen 2011). Once the technical hurdles of creating viable offspring of extinct animals are overcome, the species becomes a reintroduction candidate. By framing de-extinction as a new kind of reintroduction project, rather than as something entirely novel, a wealth of prior experiences and established guidelines can be drawn on in de-extinction projects.

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doi:10.1525/bio.2013.63.9.6