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REWILDING

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"I would not be surprised to read someday that cheetahs are helping to control deer and that mesquite is being "overbrowsed" by rhinoceroses."

—Michael Soulé (1990: 235)

"*I take the stand as a character witness for wolf trees*."

—Charles Elliott (1945)

1. Introduction: Rewilding as a form of environmental nostalgia

Rewilding, very roughly, is any effort to return a landscape to what we imagine to be a wilder state. In recent years, popular writers have portrayed rewilding as an exciting new direction in western environmental thought (Foreman 2004; Fraser 2009; Monbiot 2013a; Tree 2019). In this overview, I will focus less on the definitional questions – what exactly does 'rewilding' mean? – and more on rewilding's relationship to different kinds of environmental nostalgia. (For further discussion of the meanings of 'rewilding,' see Jørgensen 2015; Prior and Ward 2016; Tananescu 2017; Gammon 2018; Keulartzt 2018.) Cultural theorist Svetlana Boym (2001) draws a distinction between *reflective* and *restorative* nostalgia:

> Restorative nostalgia stresses *nóstos* (home) and attempts a transhistorical reconstruction of the lost home. Reflective nostalgia thrives in *álgos*, the

> longing itself, and delays the homecoming—wistfully, ironically, desperately (Boym 2001, p. xviii).

Restorative nostalgia is more active, seeking to recreate or re-establish an imagined past. By contrast, reflective nostalgia is more accepting and more contemplative, a kind of bittersweet dwelling on what has been lost. I will argue that Boym's distinction between these two modes of nostalgia tracks a distinction between two forms of rewilding: a more passive version that involves a commitment to letting non-human nature go its own way, as contrasted with more active, interventionist versions of rewilding. My goal here is a modest one: I will try to place these two forms of rewilding into productive tension with each other. Perhaps one way to temper enthusiasms for more ambitious interventionist forms of rewilding is to remind ourselves of the value of humbler, more reflective engagement with natural processes.

The most familiar experiences of nostalgia probably involve bittersweet reminiscences about earlier moments in our own lives. It is also possible, though, to be nostalgic for past times that we have never experienced, for an imagined past. Nostalgia often involves a tacit comparison of past and present, accompanied by the thought that something valuable has been lost, or that the past (at least, as we imagine it) was in some respects better (Howard 2012). One fascinating example of restorative nostalgia, in Boym's sense, is the popular paleo diet (for critical assessment, see Zuk 2014). Converts to the paleo diet try to eat, and in some cases exercise, like our ancestors who subsisted by hunting and gathering. Paleo dieters eschew grains and other agricultural products. As the paleodiet illustrates, sometimes restorative nostalgia can involve longing for a rather

distant past that we ourselves never experiencd. But if the paleo diet is an exercise in restorative nostalgia, then so, too, is much of the sustainable agriculture movement. As Michelle Neely argues, "sustainability's ideal future often involves the recovery of an idyll" (2020, p. 10). For many, this ideal future looks like a return to an imagined pre-industrial agricultural system. The difference here concerns the targets of restorative nostalgia: are you nostalgic for world before the rise of *industrial* agriculture? Or for a world before the rise of *agriculture*? How, then, do things look when what we're nostalgic for is a wilder, less human world?

[Table 1 here.]

In what follows, I survey some of the different things that 'rewilding' has come to mean, while keeping Boym's distinction between reflective and restorative nostalgia in mind (Table 1). My survey begins with what I take to be the least controversial but perhaps also the least discussed sort of case – the unplanned, inadvertent rewilding of northeastern U.S. forests – and proceeds from there to consider more controversial proposals and cases, culminating with recent debates about the use of biotechnology to reverse extinctions. The restorative nostalgia gets more intense as we move from each of these proposals to the next. In a 2004 essay, "Letting the world do the doing," Freya Mathews argues that if we want to "return to nature" we should resist the impulse to remake landscapes according to our own designs and learn how to let things be (compare also Monbiot 2013b). This humbler, more passive attitude toward nature—a kind of environmental forbearance—is at odds with restorative nostalgia. But the more passive

stance may be the best way to live in a relatively wilder world. Interestingly, critics of rewilding tend to focus more on active rewilding projects, and have had less to say about passive rewilding (Nogués-Bravo et al. 2016). Passive rewilding sometimes gets mentioned in the course of more general discussions of rewilding (Corlett 2016: 454), but proponents of rewilding often have more ambitious interventionist projects in mind. Where rewilding advocates do focus on cases of passive rewilding, they sometimes treat them as sources of data that can inform more active rewilding projects (see, e.g. Svenning et al. 2016: 901, on learning from "spontaneous wildlife comebacks").

2. Unplanned rewilding and "the irony of eastern wilderness"

In some parts of the United States, a certain amount of rewilding is happening naturally, without much deliberate planning or management (Klyza 2001; Davis 2015). John Elder writes that "The irony of eastern wilderness is that, while it may have seemed to receive that title as a courtesy, the vector of wildness may actually be more remarkable here than anywhere in the west" (2001: 257). During colonial times and up through the nineteenth century, most of the rural landscape in Connecticut, for example, was deforested. However, agriculture went into decline as people took up other economic activities and farmers packed up and moved west to places where farming was more promising. Over the twentieth century, the forests began to come back. Today, the wooded areas protected in state forests and local land trust preserves are, to some degree, rewilded landscapes. Cockaponsett State Forest, in central Connecticut, is home to a number of "wolf trees"—huge, old sprawling oaks with branches spreading laterally, with younger maples growing around and sometimes straight up through them (Figure 1).

When you see a wolf tree, sometimes also called a "pasture tree," you know that you are standing in someone's old pasture or farm field (Shaw 2015). If the oak had started its life in the middle of a forest, it would have grown more vertically. And of course, you cannot travel very far through the woods in Connecticut, even in areas that feel relatively wild, without encountering a stone wall. Occasionally you will also run across the remains of an old charcoal kiln, or the foundations of an old farmhouse.

[Insert Figure 1 here.]

In recent decades, wild turkeys, foxes, black bears, beavers, coyotes, fisher cats, and even a few moose have rebounded and/or returned to Connecticut. According to the Connecticut Department of Energy and Environmental Protection, there over 5,000 black bear sightings in the state last year. The return of large animals is seen by many as a sign that Connecticut's woodlands are growing wilder.

As noted above, Boym (2011) contrasts restorative nostalgia with *reflective nostalgia*. This second variety of nostalgia does not seek to recreate a longed for past. Instead, Boym writes that reflective nostalgia "savors details and memorial signs," and that it involves a "meditation on history and passage of time" (2011, p. 49). The contemplation of a wolf tree or a stone wall in a regrown forest is a good example of reflective nostalgia. There's no effort or even any desire to recreate the farmstead that the forest is slowly obliterating. But there is still something bittersweet in the experience of contemplating the wolf tree, as one is reminded that rewilding entails the gradual loss of

traces of a more humanized landscape with which we can easily identify. Matthews (2004) captures this same feeling of reflective nostalgia when she writes that

> 'returning to nature' in an urbanized world means allowing this world to go its own way. It means letting the apartment blocks and warehouses and roads grow old … Gradually such a world, left to grow old, rather than erased for the sake of something entirely new, will be absorbed into the larger process of life on Earth. Concrete and bricks will become weathered and worn. Moss and ivy will take over the walls. Birds and insects may colonize overhangs and cavities within buildings … Left to itself, the living world reclaims its own (2004, p. 4).

The difference between restorative and reflective nostalgia closely tracks the difference between wolf reintroduction and wolf trees. Whereas restorative nostalgia seeks to alter nature in accordance with human designs, reflective nostalgia lingers on the traces of a human world that nature has reclaimed. Of course, reflective nostalgia could in principle work the other way, too. One could also experience reflective nostalgia upon contemplating a remnant of wild nature in an area that is rapidly urbanizing. If anything, the contemplation of a wolf tree in the northeastern woods may involve a double-reflection: the reflection on nature's reclaiming the landscape that Euro-American settler colonists had modified may also inspire reflection upon earlier periods of the landscape's history.

Connecticut, which is the fourth most densely populated state in the U.S., probably does not leap to mind as an example of a wild place. It has no national parks and no wilderness areas, although the Eightmile River, which feeds into the Connecticut River about eight miles above Long Island Sound, has received federal designation as a Wild and Scenic River. But the reforestation of the state over the last century has brought with it some unplanned, inadvertent rewilding, and that process is pretty far along in some places. These changes make the northeastern U.S. an excellent case study to think about when assessing more ambitious proposals for rewilding in other regions (Klyza 2001). Here we can get a good handle on some of the downsides of rewilding, which include increased potential for human-wildlife conflicts, as well as very serious habitat reduction for some species, such as birds that prefer meadows. But we can also see some of the advantages, which might include, in addition to some of the more obvious conservation benefits, the spiritual and aesthetic benefits of living in closer proximity to relatively wilder places.

Prior and Brady (2017) explore some of the connections between environmental aesthetics and rewilding. However, they focus more on active rewilding, defining it as "a process of (re)introducing or restoring wild organisms and/or ecological processes" (p. 34). This discussion of passive rewilding suggests a need for broadening the discussion of rewilding and aesthetic engagement. Reflective nostalgia is a distinctive way of engaging aesthetically with landscapes, and reflective nostalgia involves contemplating the history of the landscape. Understanding the history of a landscape can enhance our aesthetic engagement with it and help us to cultivate a sense of place (Turner 2019).

3. Rewilding as a Conservation Strategy: Cores, Corridors, and Carnivores

Unplanned rewilding in the northeastern U.S. is a far cry from what conservationists had in mind when they first introduced the term "rewilding" in the 1990s. In 1998, Michael Soulé and Reed Noss published a programmatic essay recommending rewilding as an approach to conservation biology (compare also Noss 1998 and Foreman 2004). Their original idea was not too radical, though as we'll see, others have in the meantime picked up on it and carried it much further. Soulé and Noss recommended an approach that emphasizes the three C's: cores, carnivores, and corridors. The "cores" they envisioned were large, undeveloped wilderness areas, such as those established in the western U.S. under the Wilderness Act of 1964. Soulé and Noss also emphasized the reintroduction of keystone species, especially carnivores. This emphasis on reintroduction of animal species also helped distinguish rewilding from traditional restoration ecology, which tends to focus more on reconstructing plant communities. Soulé and Noss worried about trophic cascades that can happen when a top predator is removed from an ecosystem. Many biologists think that this happened, for instance, when wolves were removed from the greater Yellowstone ecosystem in the early part of the twentieth century. The species that the wolves had preyed upon – especially elk and mule deer – increased in abundance with damaging effects on other populations. Finally, Soulé and Noss stressed the importance of connectivity among the core wilderness areas. Rewilding, they argued, should entail the creation of wildlife corridors so that populations do not get stranded in isolated pockets of protected

wilderness. The corridors would facilitate the movement of populations between protected areas.

One important goal of rewilding, as Soulé and Noss conceived of it, was to build a bridge between biodiversity conservation and wilderness protection. One consequence is that rewilding inherits all the problems that theorists such as William Cronon have identified with the concept of wilderness (Cronon 1996; for more discussion, see the papers collected in Callicott and Nelson 1998). Protecting biodiversity and protecting wilderness are distinct environmental concerns. Sometimes, these values can pull in different directions. For example, protecting biodiversity might require human intervention in nature, ranging from efforts to eradicate invasive species to efforts to breed endangered animals in captivity. These sorts of interventions do not sit well with the idea that wild places have special value precisely because humans have not interfered with them. Rewilding, in the sense of Soulé and Noss, draws upon wilderness advocates' idea that we should be setting aside big roadless tracts of land – the "cores" – and placing them off limits for most human activities. They also argued that reintroducing big keystone species – the "carnivores" – would restore the "emotional essence" of wilderness (1998: 7). Finally, they claimed that rewilding would be an effective strategy for protecting biological diversity. For example, connecting wilderness cores is often crucial for the protection of migratory species. And the trophic cascades that result from the loss of top carnivores can also be bad for diversity. If fewer wolves kill fewer elk and mule deer, overbrowsing will have an impact on plant species.

Perhaps there is some internal tension in the idea that human beings can do anything at all to make a landscape wilder (Katz 1992). Some wilderness advocates

might favor an immediate "hands off" approach: if we want wilder landscapes, the best approach is not to intervene at all, but rather to let nature go its own way. In reply to this concern, advocates for reintroducing keystone species might argue that their goal is, ultimately, to let nature go its own way, at least in protected, rewilded areas. The crucial issue is the starting point: should we take a "hands off" approach now and let a damaged and degraded landscape go its own way? Or should we actively undertake some restoration/reintroduction efforts first, with the aim of taking a more hands-off approach later on when the system is in a better condition? Proponents of rewilding tend to favor the second approach of slowly managing our way back to a wilder landscape. Taking an immediate "hands off" approach might not be the best way to minimize the overall human impact on a landscape. Although it may sound paradoxical, in a case where human activities have already significantly altered a landscape (say, by exterminating a keystone species), advocates of rewilding, in the sense of the three C's, argue that some further human intervention might be needed to make the landscape wild again.

Notice how different Soulé and Noss's vision of big, interconnected wilderness areas is from the process of inadvertent rewilding that has occurred in the northeastern U.S. The rural landscape in Connecticut is arguably wilder than it used to be, but of course the state has no significant roadless wilderness areas. Some carnivores – especially foxes and coyotes – have rebounded or moved in. But there are (so far) no significant populations of wolves or mountain lions, though there are alleged sightings of big cats. At the very least, we need to distinguish between planned and unplanned rewilding, but intentionality (or lack thereof) is not the only difference between the two cases. Another difference is that in the northeast, the areas that are, in some sense,

getting wilder are also fairly densely populated. The Soulé and Noss model inherits from the wilderness movement an emphasis on protecting places where nobody lives. This is too bad, because it ignores the fact that places where people live can also become relatively wilder. Soulé and Noss's proposal has inspired a variety of rewilding projects around the world (Fraser 2009; Manning 2009; Monbiot 2013). And as we'll see, a few conservationists in Europe and North America have carried the idea to new extremes.

4. Pleistocene Rewilding

The hedge apple tree, or Osage orange (*Maclura pomifera*), is a lovely example of an evolutionary anachronism (Janzen and Martin 1982; Barlow 2002). It has marvelous bumpy green fruits the size of softballs. Plants that produce enticing fruit have typically co-evolved with animal species that serve as seed dispersers. The striking thing about hedge apples is that there are no wild animals in North America today that are big enough to eat them. The only animals that even come close are bison, but they are primarily grazers. Almost certainly, the original seed dispersers for the Osage orange were mammoths and mastodons, creatures that were extinct by the end of the Pleistocene, 12-11,000 years or so ago. It's tough to think about these evolutionary anachronisms—and there are many of them in the western hemisphere, from avocados to honey locust trees to pronghorn antelope—without getting the sense that something is missing from the ecosystem.

One challenge for restoration ecologists is to determine the historical reference conditions for a particular project (Callicott 2002; Higgs 2003). In general, and setting aside many philosophical complications, restoration ecologists start with ecosystems that

human activities have damaged, and they seek to restore those ecosystems to an earlier, undamaged state. In some cases in North America, it may be tempting to try to restore environments to conditions prior to the arrival of European settlers and colonists. That approach, however, seems to assume that Indigenous North Americans did not impact their environments much, which is inaccurate. Certainly, when Europeans arrived, the North American landscape had already been used and modified by people for thousands of years. For example, at places like Cahokia, Illinois, there were large population centers with monumental architecture, supported by extensive agricultural systems and trading networks (Pauketat 2009). One might think that the more principled approach is to restore North American ecosystems to the condition they were in before any human beings showed up at all. This is the idea that animates Pleistocene rewilding. Just which people got to North America first, how they got there, and where they came from, are all issues that archaeologists continue to investigate. We know that people had occupied North America by 11,000 – 12,000 years ago, though there are controversial hints that they might have arrived considerably earlier. Although Pleistocene rewilding might seem more principled than other forms of restoration because the goal is to return the landscape to something like the condition it was in before human migration to the Americas, it is also vulnerable to the objection that it is just contributing to the erasure of Indigenous communities from North America.

One early advocate for Pleistocene rewilding, Paul Martin (1995), also defended what is known as the Pleistocene overkill hypothesis. According to this view, human hunting contributed to the end-Pleistocene extinction of the megafauna in North and South America, including everything from woolly mammoths to giant ground sloths. The

hypothesis gains some plausibility from better understood cases where we know that humans rapidly exterminated large animals. For example, when the Maori arrived in New Zealand, it did not take long for hunting pressure to contribute to the extinction of the flightless moa (Perry et al. 2014). Nevertheless, the Pleistocene overkill story remains controversial as an explanation of continental extinctions (Koch and Barnosky 2006, Wolverton 2010, Cooper et al. 2015). There is evidence in the archaeological record that humans hunted mammoths, but many other species in North and South America went extinct at the end of the Pleistocene, and there's no clear evidence that humans hunted any of them. For present purposes, the important thing to see is that if the Pleistocene overkill hypothesis were to turn out to be correct, then it might appear to lend some support to the Pleistocene rewilding idea, at least when it's conjoined with certain normative assumptions. For starters, the Pleistocene Overkill hypothesis would imply that human activities impacted North American ecosystems very early, perhaps not long after humans arrived. Some have the intuition that we have some special obligation to try to repair damage that our species has done. The Pleistocene overkill hypothesis gives rewilding the feel of atoning for past environmental sins.

What would Pleistocene rewilding actually look like in North America? Notwithstanding recent work on de-extinction, to which I will turn in the next section, the Pleistocene megafauna appear to be gone for good. But as Josh Donlan and colleagues (2005; 2006; Sandom et al. 2013) pointed out, the extinct megafauna of the western hemisphere have relatively close evolutionary cousins in Africa and Asia (compare also Martin and Burney 1999, Galetti 2004). And some of those existing species are threatened by habitat loss and poaching. Occasionally, in ecological restoration, where

one species is completely extinct one might introduce a closely related surrogate. Introducing large mammals from Africa and Asia into North American landscapes could be a way of hedging our bets against extinction. Even if the species disappear from their original ranges, they might hang on in "rewilded" North American landscapes. Lions and cheetahs, Bactrian camels, African elephants, and—who knows—perhaps even rhinoceroses—could serve as surrogates for extinct evolutionary cousins that once roamed North America.

Pleistocene rewilding builds on the "three C's" of Soulé and Noss (1998). The idea is to create a network of large, interconnected wilderness cores, while reintroducing keystone species, especially carnivores. Pleistocene rewilding just takes things further by seeking to introduce *proxies* for keystone species that have been extinct for 11-12,000 years. Critics, however, have raised a number of concerns (Smith 2005; Rubinstein et al. 2006, Caro 2007; Hintz 2007; Oliveira-Santos and Fernandez 2010; Sandler 2012, pp. 91ff.; Minteer 2019). Some see this proposal as tantamount to an assisted biological invasion, and one that could do more ecological harm than good. It is not so easy to predict what sorts of ecological impacts elephants and rhinos might have in the American west. There is also great potential for human/wildlife conflict. (Re)introducing megafauna to North America could diminish people's appreciation of the biological diversity that's already there. It also sounds more than a little condescending to import wildlife from other parts of the world on the grounds that conservationists in the U.S. know better how to protect biodiversity. That aspect of Pleistocene rewilding has echoes of colonialism. And given the history of often violent displacement and erasure of Indigenous communities in North America by Euro-American settlers, Pleistocene

rewilding can look like a problematic form of restorative nostalgia, like an effort to reverse the impacts that Indigenous people had on North American landscapes.

In addition to Donlan and colleagues' call for Pleistocene rewilding in western North America, Soulé and Noss's proposal has also been carried forward in fascinating ways by conservationists in Europe. One especially important test case for thinking about rewilding is the Oostvaardersplassen, in the Netherlands (Marris 2009, Kolbert 2011). The site is on land reclaimed from the North Sea; in prehistoric times, it was under water. But Dutch conservationists working at the site have set out to challenge the view that prehistoric Europe was heavily forested. Their hypothesis is that big grazing animals—horses, aurochs (ancestral cattle that went extinct in the 1600s), deer, and wisents (European bison)—would have maintained grassland ecosystems. And they've set about recreating such an ecosystem at the Oostvaardersplassen, not too far from Amsterdam. They have brought in red deer as well as konik horses from Poland, which biologists think are closely related to the ancestral horses that roamed around prehistoric Europe. Most controversially, a breed of cattle known as Heck cattle are being used as proxies for the larger aurochs. The Heck cattle get their name from Heinz and Lutz Heck, two German scientists who in the 1930s set about to recreate the prehistoric aurochs by back breeding existing types of cattle. Part of the controversy has to do with the Heck brothers' close association with Nazism: the restorative nostalgia evident in their back-breeding program was affiliated with a more insidious political nostalgia for an imagined past characterized by racial purity. As it happened, the Heck brothers' efforts fell well short of recreating the aurochs anyway (Lorimer and Driessen 2013, Gremmen 2014).

Meanwhile, in Russia, a conservation biologist named Sergey Zimov has actually created a so-called "Pleistocene Park" in a remote part of Siberia (Zimov 2005). His stated goal is to recreate the ecosystem known as the "mammoth steppe." The mammoth steppe was a grassland that once stretched across much of Asia and North America, and was maintained by woolly mammoths and other big grazing animals. Today, in its place, we have tundra and taiga ecosystems. Pleistocene Park is currently home to a number of re(introduced) herbivores, such Yakutian horses, musk oxen, reindeer, and even some bison imported from Canada. The thought is that over time, having healthy populations of big herbivores will convert some of the existing wet mossy tundra into a drier Pleistocene grassland. This could have the effect of reducing soil temperatures and slowing the loss of permafrost in an era of climate change. The Yakutian horses were the first species reintroduced, and a small population of them persists in the park today. According to the Park's website, six baby musk oxen were imported from Wrangel Island in 2010. All were males (Zimov 2014). It's not clear whether the project has achieved any major ecological results. Nor is it clear that the experiment in Pleistocene Park could be scaled up in a way that might make it relevant to climate change.

Part of the initial motivation for rewilding in the North American context is to restore the ecosystem to something resembling the condition it was in before humans arrived. In the European and Siberian contexts, however, humans and our close evolutionary ancestors (e.g. the Neanderthals and Denisovans) have impacted the ecosystems for tens of thousands of years. In those areas, humans were part of the Pleistocene landscape, and the motivation for rewilding may be somewhat different. Boym (2001: xiii) characterizes nostalgia as "a longing for a home that no longer exists."

Our species has arguably spent much of its evolutionary history living in grassland environments—and those are the environments that people are trying to recreate in the Oostvaarderplassen and in Pleistocene Park.

5. De-extinction

Pleistocene rewilding, as originally conceived, was an attempt to recreate Pleistocene environments using living animals as surrogates for the extinct megafauna. But if you think this is a good idea, you might also think that we should go a step further, and try to recreate the extinct animals. Although proponents of Pleistocene rewilding do not necessarily support de-extinction, any arguments in favor of recreating the mammoth steppe would also seem to lend at least some support to recreating the mammoths that once lived there. Indeed, Zimov's (2005) name for the rewilding project in Siberia—"Pleistocene Park"—hints at an ambition to bring back the extinct animals themselves, in the spirit of *Jurassic Park*. As it happens, the debate about Pleistocene rewilding unfolded in the 2000s at the same time that scientists began to develop techniques for paleogenomic sequencing. In 2008, for example, scientists published a draft sequence of the genome of the extinct woolly mammoth (Miller, et al. 2008). That immediately fueled speculations about using biotechnology to recreate the mammoths, and perhaps other extinct species (Nicholls 2008). Science writer Olivia Judson (2008) referred to this as "resurrection science," and it has since come to be known as de-extinction. The movement has gained considerable momentum, with a major TEDx conference on de-extinction sponsored by the National Geographic Society in the spring of 2013, as well as recent popular books (e.g. Shapiro 2016; Kornfeldt 2018; Wray 2019).

Except for small populations of holdouts on remote islands, woolly mammoths went extinct by 10,000 years ago. Carcasses preserved in permafrost contain genetic material that is in good enough condition for scientists to sequence. If we shift the focus to more recently extinct creatures, and to cases where humans' role in causing the extinction is less controversial, it turns out that natural history museums around the world contain a great many specimens whose fur and feathers could supply genetic material for sequencing (Wandeler, et al. 2007). The Heck brothers' back breeding project, mentioned above, could be seen as an early and relatively unsophisticated attempt at de-extinction. In the last few years, scientists have begun to explore some other options that would take full advantage of the latest biotechnology.

The most straightforward approach would be to use genetic engineering (Shapiro 2016). If you could identify the woolly mammoth genes responsible for, say, long hair, those could theoretically be spliced into the genome of an Asian elephant (the mammoths' closest living relative). Remarkably, scientists have succeeded in using genetic engineering to create bacteria that produce mammoth blood protein (Campbell, et al. 2010). Another more complicated approach that is probably much further over the technological horizon would be to recreate the full complement of chromosomes of some extinct species, enclose them in a cell nucleus, and then insert that nucleus into an enucleated egg cell taken from some living near relative of the extinct species. This approach uses the same technology that scientists used in the 1990s to clone Dolly the sheep, but with the added twist of using two different species. As it happens, scientists have already succeeded in cross-species cloning with two living species—African wildcats and housecats (Gomez, et al. 2004; for another example, see Lanza 2000).

De-extinction remains somewhat speculative, and it's entirely possible that in spite of the efforts of enthusiasts, the technology will never pan out. We're still a good way from being able to reintroduce extinct populations into the wild. We shouldn't assume that because we know how to clone some species that cloning a woolly mammoth would be straightforward. Nicholls (2008) describes some of the technical challenges, starting with the difficulty of harvesting eggs from female elephants. On the other hand, it was not so long ago that cross-species cloning and genetic engineering using DNA from extinct species would have sounded to well-informed people like science fiction. So it behooves environmental philosophers to begin thinking seriously about de-extinction.

De-extinction raises some conceptual questions as well as ethical ones. For example, it puts some pressure on our intuitions about the meaning of 'extinction' (Delord 2007, 2014; Siipi and Finkelman 2017). Is it an analytic truth that extinction is irreversible? De-extinction is also an interesting test case for the view that biological species are historical individuals. In his classic statement of that view, David Hull wrote that "if a species evolved which was identical to an extinct species of pterodactyl save origin, it would still be a new, distinct species" (1978: 349). This is a point about qualitative *vs*. numerical identity. The new species might be exactly like the extinct one, but it wouldn't be one and the same individual. The interesting issue here, from the perspective of philosophy of biology, is whether the historical connection between the mammoths of the Pleistocene and a mammoth-like animal created by biotechnologists would be the sort of connection that would ensure the continuity of the species *qua* historical individual (Siipi 2014 further explores these issues).

Setting aside these and other related issues in the philosophy of biology, philosophers have also begun to explore questions about the ethics of de-extinction (Salsberg 2000; Sherkow and Greely 2013; Oksanen and Siipi 2014; Gamborg 2014; Sandler 2017; Kasperbauer 2017; Minteer 2019). Two of the more serious problems with de-extinction have to do with animal welfare and resource allocation. Although the animal welfare concerns will depend upon the species under consideration as well as the techniques being used, the going proposals for de-extinction (e.g. cloning) would likely mean pain and distress for large numbers of animals (Turner 2017, Browning 2018). This issue is not unique to de-extinction, as other conservation methods, from captive breeding to the eradication of invasives, also raise animal welfare concerns. Secondly, de-extinction also represents "big science" requiring significant levels of funding that could be put to better use in the service of biodiversity conservation. A major concern is that the de-extinction drama is drawing private funding away from other conservation efforts where it would likely do more good (Bennett, Maloney, and Steeves et al. 2017).

The strongest argument in favor of de-extinction is one that I have elsewhere called "the restorationist argument" (Turner 2014). This argument is essentially the same as the one that proponents of rewilding have made for reintroducing locally extinct keystone species.

P1. In general, it is a good thing to try to promote ecosystem health.

P2. In some cases, the loss of some particular species is damaging to ecosystem health, and the reintroduction of that species, if successful, would help restore the system to health.

C. Therefore, in those cases, it is a good thing to try to reintroduce species that have gone extinct.

Perhaps the most interesting feature of this argument is that it's neutral with respect to the difference between reintroducing a species that's extinct in some portion of its historic range—think of the bolson tortoise from the previous section—and reintroducing a species that's extinct, full stop. This argument is vulnerable to objections. For example, it depends crucially on the notion of ecosystem health, which some have challenged (Jamieson 1995). But if we wanted to, we could replace "ecosystem health" in the above argument with some other set of ecological features that we might agree we wish to promote by reintroducing a species that has been absent from the system for some time. Note also that it's an empirical question whether re-introducing an extinct species would actually promote ecosystem health. It could well turn out that this is hardly ever the case. And even if it were the case, this line of argument could (and likely would) still be trumped by concerns about animal welfare and resource allocation. Another potential problem with the argument is that it might overshoot the mark and justify interventions that do not involve restoring lost biological diversity. If we could somehow show that adding a new species to an ecosystem would improve the health of that system—a big if, of course—then the argument might justify such an introduction. In presenting the

argument here, my main goal is to make an observation about its structure: namely, that the case for de-extinction is structurally very similar to the original argument for reintroducing wolves into Yellowstone.

Many conservationists will, I'm sure, have a lot of sympathy for rewilding as Soulé and Noss originally conceived it. But many will want to jump ship once the conversation turns to Pleistocene rewilding or, even worse, de-extinction. A simple science fiction thought experiment will show how difficult it is to draw a principled line here. (See also Minteer 2019 for a rich and helpful discussion of some of these line-drawing problems.) Suppose that gray wolves have been totally extinct for decades. The reintroduction of wolves into Yellowstone never happened. But someone figures out how to use biotechnology to create a viable population of wolves, so that the reintroduction can go forward. Surely anyone who favors rewilding, in Soulé and Noss's sense, should also favor the reintroduction in this case (setting aside concerns about animal welfare and resource allocation). In both cases, there is significant human involvement in nature—trapping and relocating wild animals vs. recreating them—done for the sake of eventually letting nature go its own way.

De-extinction is a challenging topic that deserves more attention from philosophers. Here I have only introduced a few of the relevant ethical considerations. The main point I want to convey, however, is that de-extinction can be seen as an extension of earlier calls for rewilding. Earlier discussions of rewilding and especially Pleistocene rewilding are crucial context for understanding how the de-extinction debate has taken shape. The best available argument for de-extinction is just a version of the rewilders' argument for reintroducing keystone species. Although de-extinction

advocates are now focusing on a variety of more recently extinct species, the sequencing of the mammoth genome was the big event that gave momentum to de-extinction. And the interest in woolly mammoths comes right out of the Pleistocene rewilding debate and Paul Martin's advocacy of the Pleistocene overkill hypothesis, not to mention Zimov's project of restoring the mammoth steppe. Remarkably, a recent article on de-extinction in *The New York Times Magazine* had a woolly mammoth on the cover, but the article scarcely mentioned mammoths at all. It was all about passenger pigeons (Rich 2014). The mammoth has become the emblem of de-extinction, even if it is not a terribly good de-extinction candidate. More recently extinct species whose habitats still exist would presumably be better candidates.

Finally, note that de-extinction research is an especially clear example of what Boym calls "restorative nostalgia." It's driven by a nostalgic impulse to bring back things from the past that have been lost, seemingly for good.

6. Conclusion: The Intensification of Restorative Nostalgia

In this overview, I've considered a spectrum of possible rewilding proposals, ranging from the less controversial to the more controversial. At the easy end of the spectrum we have cases of unplanned, inadvertent rewilding that few would find objectionable, although those do come with greater potential for human/wildlife conflict. I then considered Soulé and Noss's (1998) proposal, which in hindsight seems fairly mainstream, to create core wilderness areas, connected by corridors, with reintroduced keystone species. This has spawned a number of more ambitious proposals to recreate prehistoric ecological conditions, often using living animals as proxies for extinct

keystone species that went extinct. Prehistoric rewilding leads inexorably to the idea of using biotechnology to recreate those extinct keystone species, and current work on de-extinction can be seen as an outgrowth of the rewilding movement.

At each stage of the narrative that I've constructed, the restorative nostalgia grows more intense. Indeed, at the first stage, the unplanned, *passive rewilding*, the urge to recreate past conditions is largely absent, and the rewilding has occurred as an accidental side effect of changes in land use patterns. Unplanned rewilding might induce a more reflective nostalgia for the human-altered landscape that's disappearing, a reflective nostalgia that goes hand-in-hand with a willingness to "let the world do the doing" (Mathews 2004). The move toward purposeful, *active rewilding* comes with restorative nostalgia. Even in the original rewilding proposal that emphasized the three C's—cores, corridors, and carnivores—the reintroduction of keystone species is tinged with restorative nostalgia, and a drive to put things back the way we imagine they were. The more radical proposals for Pleistocene rewilding represent nostalgic efforts to recreate Pleistocene environments. The movement to recreate extinct species indulges the restorative nostalgia even further.

The de-extinction movement is all about using the latest, fanciest, and most expensive biotechnology to fix perceived environmental problems. Indeed, if scientists could successfully cheat extinction, that would be a significant technological and scientific milestone. I myself have argued that the case for de-extinction might be a bit stronger than some critics realize, at least for some recently extinct species (Turner 2014; and see Seddon et al. 2014 for an attempt to prioritize de-extinction candidates). However, we should also bear in mind that de-extinction is completely antithetical to

"letting nature itself decide much more and man decide much less." Whatever you think about the value of wildness, it's not even remotely plausible to say that a bioengineered herd of mammoth-like animals living in a heavily managed Pleistocene Park would be wild. The harder we try to make the world wilder, the further we get from the goal of living in a relatively wilder world.

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Related topics:

40. Sustainable agriculture

42. Remediation

43. Restoration

47. Novel ecosystems

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Reflective nostalgia	Restorative Nostalgia		
Passive rewilding	*"Three C's" Rewilding*	*Pleistocene Rewilding*	*De-Extinction*
Wolf trees in a northeastern woodland	Reintroduction of gray wolves to Yellowstone	Introducing ecological proxies for long extinct megafauna (e.g. elephants for woolly mammoths)	Using biotechnology to create ecological proxies that have the traits of extinct species (e.g. elephants with mammoth-like traits)
Little or no human intervention	*Intensification of intervention* →		

Table 1. Varieties of rewilding

Figure 1. A wolf tree in Cockaponsett State Forest, Connecticut, USA. Photograph by the author.

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