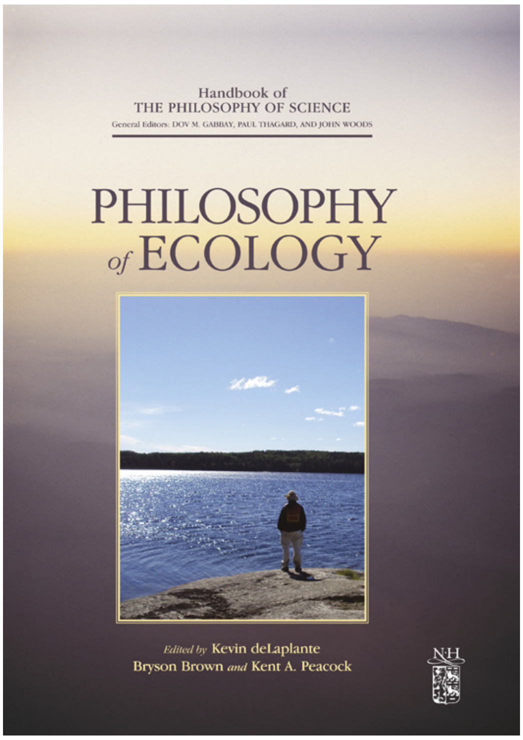

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HABITAT RECONSTRUCTION: MOVING BEYOND HISTORICAL FIDELITY

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1 INTRODUCTION

Today, only the very fortunate live and work in landscapes that do not bear the indelible mark of continuing highly intrusive anthropogenic transformation. Biota continue to be replaced by human artefacts or to be confined to small sub-optimal patches. Ecological and physical processes often manifest themselves only in forms dominated by the effects of human action. Besides the obvious harm to biota, the consequences of how land- and seascapes have been treated by human activities have typically included the depletion of natural resources, the deterioration of air and water quality, and our increased vulnerability to extreme weather events. We continue to alter climate in ways that may jeopardize the well-being of future generations.

All this is common knowledge, and often presented with much more rhetorical flourish than in the paragraph above. The standard twentieth-century response to these problems has been calls for increased reservation, setting aside land- and seascapes to preserve natural values. On land, at least superficially (that is, on paper if not in practice), this strategy has been quite successful during the last 25 years (1980–2005). By 2005, 17.1 million km^2 or 11.5% of Earth's terrestrial surface was supposed to be under some form of protection.[1] This is close to the 12% target, then considered visionary, that the Brundtland Commission recommended in 1987.[2] So far, the seas have not fared as well: only 2.35 million km^2 or 0.65% of the sea surface are under the aegis of a conservation plan.[3] However, efforts to designate more marine reserves continue.[4]

Nevertheless, if the long-term retention and enhancement of natural values is among our aspirations, reservation is not enough for at least six reasons.

1. The scale of the human impact on nature over the last few centuries has been so extreme that not enough areas with flourishing natural values remain.

[1] Naughton-Treves *et al.* [2005]. Most estimates are similar though the exact number depends on the criteria used to define protected areas.

[2] WCED [1987].

[3] Wood *et al.* [1987].

[4] See, for example, [Wood, 2007] for a global analysis aimed at protecting 1,038 fish and marine mammal species.

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Even barely intact ecosystems (those with only a majority of their traditional biological components remaining viable) are becoming increasingly rare.

2. If genuine protection from human abuse is the relevant criterion, the numbers in the last paragraph are inflated. Some of these "protected" areas allow a wide range of human activities, including resource extraction so long as it is touted to be sustainable.[5]

3. Many of these protected areas are "paper parks," designated as such by some legal authority, but not implemented on the ground due to the lack or resources, political will, or both.

4. If biodiversity is one of the natural values that the areas are supposed to protect, almost 80% of the protected areas are not viable because they are less than 10,000 hectares in size[6] and thus not likely to ensure the long-term persistence of all their biota if they are isolated from other natural habitats.

5. Moreover, even if designation of new protected areas continues at the relatively high rate of the 1980–2005 period, which is unlikely, most new protected areas will continue to be small. Further transformation of the land will increasingly isolate these areas.

6. Perhaps most importantly, to maintain these individual protected areas in viable states (that is, to prevent habitat deterioration within them) will require active management: mere reservation will not be enough. There is no such thing as benign neglect any more: the human impact on Earth is now far too extensive and much too harsh.

For reasons such as these, it is by now widely recognized that we must move beyond reservation and actively manage habitats to enhance the natural values embodied in them.[7] Typically such efforts are viewed as ecological *restoration*. The aim of this paper is to argue that restoration as now understood by those who advocate it most systematically—for instance, the Society for Ecological Restoration International—is far too restrictive in the scope of its aims. The standard theoretical characterization of ecological restoration—though not always how it is practiced—is that it has two goals: ecological integrity and historical fidelity.[8] Both are normative goals that are supposed to guide policy. Ecological integrity is

[5] Naughton-Treves *et al.* [2005].

[6] This figure refers to any of the Types I–VI protected areas of the classification due to IUCN (the World Conservation Union, formerly known as the International Union for the Conservation of Nature and Natural Resources). If only strictly protected areas are considered the percentage would likely be even higher since these typically tend to be small in size.

[7] Hobbs & Norton [1996].

[8] See [Higgs, 2003, p. 95]. Hobbs and Norton [1996] also emphasized how restoration efforts (broadly construed, that is, what is being called habitat reconstruction here) should be guided by a dynamic criterion and a reference state criterion. Much earlier, Bradshaw and Chadwick [1980] had also implicitly embraced a dynamic criterion and a reference criterion (see the discussion below in Section 3).

what will be called here a *dynamic criterion*, that is, one specifying how a system should change over time.[9] Very roughly, it is a measure of how intact a system is in the way it behaves (see Section 4 for more detail). In contrast, *historical fidelity* is what will be called a *reference state* criterion, specifying, again roughly, what a system looks like as captured by its state variables (see Section 5).

We shall see, below, that ecological integrity may be questionable as a goal, or at least, as the only dynamic (or functional) goal of natural value enhancement programs. However, the real trouble with restoration is its insistence on historical fidelity as the (reference state) goal of such efforts. This paper will argue that there is rarely any justifiable normative ground for deifying historical fidelity, even without worrying about whether it is achievable in practice, or whether it is worth the resources it would consume.[10] Rather, habitat reconstruction should embrace the enhancement of a wide array of natural values through active intervention. Restoration, as the specific goal of habitat management, is a development of fairly recent vintage. The other natural values that are being advocated here formed part of many past habitat management efforts that have been called by a variety of names, especially before 1980—for instance, reclamation,[11] regeneration,[12] rehabilitation,[13] and revegetation,[14] besides, of course, reconstruction,[15] which is what this paper endorses.

To ground the later theoretical discussion in a tangible context, Section 2 presents an example in some detail: this is the case of the Balcones Canyonlands National Wildlife Refuge in central Texas, some 70 km west of Austin, Texas. Section 3 will note how the enhancement of degraded habitats, that is, their management for the enhancement of natural values, hereafter called *habitat reconstruction*, came to be conceptualized as restoration in the 1980s and 1990s. This is a complicated story, one that historians and philosophers have barely begun to explore,[16] and only a very few themes can be tracked here. Section 4 will note some problems with ecological integrity as the dynamic goal of reconstruction efforts but will then set that problem aside for more detailed exploration on some other

[9]This may initially appear strange because most definitions of ecological integrity explicitly refer to the state of an ecosystem (what species are in it, etc.) rather than how it is changing. However, when we probe deeper, the concern is typically over processes and, thus, about dynamics.

[10]Although this paper intends to give a fairly broad philosophical interpretation of what is called *ecological restoration* (and delves into some of its history), it does not address foundational issues about the science of *restoration ecology*. For an entry into that philosophical discussion, see Callicott [2002] and his similar contribution to this volume. Within restoration ecology, Higgs and Norton provide an influential pioneering discussion.

[11]See, for instance, [Kohnke, 1950; Costigan *et al.*, 1981; Schaller and Sutton, 1978]. Higgs [2003, p. 99] traces this term back to the late 1800s. In the United States, it was legally defined in 1977 by the Surface Mine Control and Reclamation Act [Jackson *et al.*, 1995].

[12]See, for instance, [Lewis, 1976].

[13]See, for instance, [US-NAS, 1974; Gudin and Syratt, 1975; Dibble and Bartha, 1979].

[14]See, for instance, [Gemmell, 1973; 1974; Johnson *et al.*, 1976].

[15]See, for instance, [Hall, 1941; Bradshaw, 1983].

[16]See, in particular, [Higgs, 2003; Hall, 2005]. A significant part of this paper is a response to [Higgs, 2003] which is a powerful statement of a different perspective.

occasion. Section 5 will argue the case against the pursuit of historical fidelity as a necessary normative goal of restoration. Section 6 will then explore other natural values that can also credibly (that is, with normative justification) serve as goals of habitat reconstruction. Section 7 will finally state the reconstructionist agenda in some detail. Section 8 will draw some conclusions. The most salient one will be noted here to prevent misunderstanding of the aims of this paper: much—though not all—of the *practice*, rather than the theory, of what is called ecological restoration remains untouched by this critique. That practice often does not adhere to the definition of restoration advocated by theorists—and that is how it should be. In fact, the reconstructionist agenda offers normative support for many of these broader practices. The analysis presented here should be viewed as an attempt to provide better foundations for those practices. Throughout, this paper draws heavily on examples from Texas because habitat reconstruction is typically best begun at home no matter where you happen to live.

2 THE BALCONES CANYONLANDS

The Hill Country of Texas is the eroded southeastern fringe of the semi-arid Edwards Plateau which is a large ($> 70{,}000$ km^2) oblong region of central Texas defined by its bedrock, thick flat layers of hard early Cretaceous limestone, sometimes 3,000 m deep. Its northern and southwestern limits are not geologically well-defined.[17] The Hill Country forms its southeastern border and gets its name from its many hills and valleys. Its northwest border is also not sharply defined, blending into the rest of the Edwards Plateau, but the southeast consists of the Balcones Escarpment, a now inactive fault line that resulted from a major upheaval in the Tertiary era. This is not a high cliff in spite of its name; rather, it is a band of canyon country also known as the Balcones Canyonlands. It marks a transition from the plateau to the plains of the south and east.

Around the city of Austin, in the north-eastern Balcones Canyonlands, natural habitat management is focused on two endangered migratory bird species, the Goldencheeked Warbler (*Dendroica chrysoparia*) and the Black-capped Vireo (*Vireo atricapillus*), which nest there during the summer.[18] Both winter in Mesoamerica and are endangered primarily because of the destruction of their nesting habitat in the United States. These are not the only species of conservation concern in the region. The limestone geology of the Edwards Plateau has led to the development of an intricate network of underground caves, fissures, and sinkholes. Erosion has led to the isolation of different underground karst cave systems from each other and resulted in the evolution of a suite of endemic cave invertebrates, several of which are endangered while the status of many others remain

[17] Fowler [2005]; Sarkar [forthcoming]. Most of the information about the Balcones Canyonlands National Wildlife Refuge used in this paper is from the latter source.

[18] Beatley *et al.* [1995]. During the discussion of the Balcones Canyonlands and other US examples, throughout this paper, the terms, “endangered,” “threatened,” etc., are being used in accordance with the US Endangered Species Act (1973).

to be properly investigated. These endangered troglobites include three insects, the Tooth Cave ground beetle (*Rhadine persephone*), the Kretschmarr Cave mold beetle (*Texamaurops reddelli*), and the Coffin Cave mold beetle (*Batrisodes texanus*), and four arachnids, the Bone Cave harvestman (*Texella reyesi*), the Bee Creek Cave harvestman (*Texella reddelli*), the Tooth Cave spider (*Neoleptoneta myopica*), and the Tooth Cave pseudoscorpion (*Tartarocreagris texana*).

Ultimately, what pushed all these species to the brink of extinction in the 1980s was the rapid urban expansion in and around Austin, and the concomitant transformation of natural habitat into residential and industrial developments. In response, during the early 1990s, the City of Austin, Travis County (which surrounds Austin), regional environmental organizations, and developers embarked on an ambitious attempt to formulate a habitat conservation plan (HCP) for ten at-risk species so as to permit continued development without violating the (United States) Endangered Species Act (ESA). A tortuous planning process[19] resulted in the creation of two protected area systems: the Balcones Canyonlands National Wildlife Refuge owned and administered by the United States Fish and Wildlife Service (USFWS) and the Balcones Canyonlands Preserve System belonging to the City of Austin and Travis County. Each system is administered separately and the focus of this paper will be on the former.

The Refuge acquisition area (that is, the geographical region within which USFWS can acquire land) is about 80,000 acres, of which 31,000 acres are planned for outright acquisition and a further 10,000 acres are envisioned to be managed under conservation easements.[20] Between 1992, when the Refuge was first established and now, about 20,000 acres have been acquired and another 2,000 acres have been put under conservation easements. Except for bird and surface vegetation surveys, the acquired areas have not been fully explored to date. So far, four aquatic and seven terrestrial troglobites have been found in the caves in the Refuge though none is yet listed as endangered or threatened. Consequently, management efforts are focused on the two endangered bird species (the Vireo and the Warbler). However, at least one karst troglobite, the ground beetle, *Rhadine russelli*, is endemic to the Post Oak Ridge which falls within the Refuge acquisition area. Four other species, a flatworm possibly of the genus *Sphalloplana*, a spider of the genus *Cicurina*, a centipede of the genus *Theatops*, and a millipede of the genus *Speodesmus*, are all believed to be unstudied species and probably also endemic to the Post Oak area. Finally four of the other species, an asselid isopod, *Caecidotea reddelli*, an amphipod, *Stygobromus bifurcatus*, a pseudoscorpion of the genus *Tartarocreagris*, and a mold beetle, *Batrisodes reyesi*, are recognized as species of concern in Texas. Since the cave habitats of these species are within the Refuge, they automatically have some legal protection even without active management.

Several rare plants are also present in the Refuge. The most interesting of these is Texabama croton, *Croton alabamensis* var. *texensis*, which is locally abundant

[19]See Sarkar [forthcoming].

[20]USFWS [2001]. We switch to the British system of measurement in dealing with the Refuge because all documentation connected with it uses this system.

in many canyons in the Refuge. Besides the Refuge population, which spills off into adjacent private lands, there are two other populations in Texas, one about 80 km north of the Refuge at Fort Hood, and one about 5 km south, at Pace Bend Park. These populations form a variety of their own (and probably should have the status of a subspecies) and the only other known populations are found in Alabama (*C. alabamensis* var. *alabamensis*) some 1,000 km away.[21] Locally rare plants include the microendemic Sycamore-leaf snowbell, *Styrax platanifolius* ssp. *platanifolius*, and the Shooting Star, *Dodecatheon meadia*. Two other species that probably merit endangered status but are yet to be listed are found in the neighborhood though, so far, have not been recorded within the acquisition area. These are the Canyon mock-orange, *Philadelphus ernestii*, and the Bracted twistflower, *Streptanthus bracteatus*. An experimental population of the latter was established within the Refuge in the 1990s but not allowed to persist at the conclusion of the experiment.

Most of the Refuge is limestone-dominated terrain. The plant community of the Refuge forms an ecotone with the mixing of species from different ecological communities. So far, over 600 plant species have been recorded in the Refuge. The historical vegetation pattern of the Refuge, as for the rest of Edwards Plateau, remains very poorly known.[22] Consequently, no habitat reconstruction effort can seriously claim to be guided by historical antecedent. Today, most of the Refuge is dominated by a variety of juniper-oak woodlands. Ashe juniper (*Juniperus asheii*) is ubiquitous as part of such woodlands and as an aggressively spreading shrub in open lands. Its spread must be managed to create sufficient desirable Black-capped Vireo habitat (see below). The oaks present vary with the terrain of the Refuge. Spanish oak (*Quercus buckleyi*) is mostly found on steep slopes and ravines; plateau live oak (*Q. fusiformis*) grows best on plateau tops and deep soil in valleys; shin oak (*Q. sinuata* var. *breviloba*) is present as thickets on very rocky plateau sites; and post oak (*Q. stellata*) is present on open savannahs on higher elevations of the Refuge—this region is called Post Oak Ridge.

Besides the juniper-oak woodlands, open grasslands are a major feature of the Refuge. Texas is famous for its wildflowers and a large diversity of these are conspicuous at the beginning of the spring and fall flowering seasons. A major problem is the spread of the invasive grass, King Ranch bluestem, *Bothriochloa ischaemum*, which has come to dominate many of the open grasslands and savannahs. Management of K. R. bluestem has proved to be particularly difficult throughout central Texas. Canyon bottoms and narrow valleys along creeks have riparian woodland corridors containing American elm (*Ulmus americana*) and sycamore (*Platanus occidentalis*) among many other species. Like the caves, the creeks have not been fully explored and may contain at-risk amphibians such as the Jollyville Plateau Salamander (*Eurycea tonkawae*) which is a candidate for listing under the ESA.

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[21] See [Ginzbarg, 1992] on designating this population as a variety. Van Ee *et al.* [2006] raise the possibility of upgrading it to a sub-species. If that happens, the population would fall under the aegis of the ESA and could potentially be listed at least as threatened.

[22] Fowler [2005].

Habitat management in the Refuge is complicated because the two endangered birds have different habitat requirements and their needs must be balanced.[23] The Black-capped Vireo prefers to nest in mid-successional shrub oak or other shrub vegetation not dominated by Ashe juniper.[24] In sharp contrast to the Vireo, the Golden-cheeked Warbler prefers to nest in climax mixed oak-juniper woodlands with tree heights between 3 and 6 m.[25] Refuge staff *restore*,[26] that is, create and maintain such habitat by the active manipulation of vegetation in a variety of ways including prescribed burning. The spread of Ashe juniper requires active control. Throughout the Refuge—and, for that matter, the entire Balcones Canyonlands—expanding populations of white-tailed deer (*Odocoileus virginianus*) are a major problem for revegetation programs because of excessive browsing. Deer herd control includes hunting besides encouraging improvement of deer habitat in adjacent lands in order to decrease pressure on the Refuge. An additional serious problem for the Vireo is nest parasitism by Brown-headed Cowbirds (*Molothrus ater*). Cowbirds are trapped during the breeding season and removed.

Management plans include identification and evaluation of sub-climax habitat for monitoring and active protection.[27] White-tailed deer herd management is also required for the Warbler, as is control of Brown-headed Cowbirds though the latter do not present as significant a problem for this species as it does for the Vireo. Oak wilt management has emerged as an important issue in several areas of the Refuge.[28] Finally, excessive public use of the Refuge has had to be curtailed in some areas during the breeding season. An important decision for Refuge management is to decide how much habitat should be managed for each endangered bird species, and where these should be located.

3 DEFINING ECOLOGICAL RESTORATION

Though there is a long and rich history of antecedents (for instance, in the highly influential work of Aldo Leopold in North America),[29] *ecological restoration*, as we distinctively understand that practice today, emerged in the early 1970s amidst the variety of reconstructionist practices that were mentioned in Section 1. The idea of restoration as the goal of habitat management was articulately promoted by two major figures, A. D. Bradshaw in the United Kingdom and John Cairns Jr. in the United States along with many other proponents. A series of conferences during the 1970s highlighted the importance of restoration. For instance, on Friday, 16 April 1971, the (United States) Association of Southeastern Biologists (ASB)

[23][USFWS, 2001, p. 7].
[24]Grzybowski [1995].
[25]Ladd and Gass [1999].
[26]USFWS [2001, p. 38].
[27]USFWS [2001, p. 37].
[28]USFWS [2001, p. 37].
[29]For the early history, see [Hall, 2005]. This book is an unusually valuable resource because it explores the history of reconstruction efforts beyond the customary North American context.

and the Center for Environmental Studies of the Virginia Polytechnic Institute cosponsored a Symposium on the Recovery and Restoration of Damaged Ecosystems at the 32nd Annual Meeting of the ASB at the University of Richmond.[30] The conference had taken three years to organize. The program proclaimed:

> Much attention has been given to the prophets of doom who are bewailing the fate of the planet, and the terrible things that are happening to the environment. However, little attention has been given to the constructive and positive approaches to coping with environmental problems, either through deliberately restoring damaged ecosystems or relieving the pollutional stress sufficiently for them to recover by themselves. This symposium will deal with practical problems and case histories described and discussed by people who have worked with these real problems and case histories. [Anonymous, 1971]

The speakers included Cairns on damaged streams, Ronald D. Hill on mines, Robert R. Curry on forests, and Thomas L. Linton on estuaries.[31] Both Hill and Linton explicitly used restoration to describe their programs in what was one of the earliest modern uses of the term in an ecological context.

Another conference at the Virginia Polytechnic Institute in March 1975 led to an edited book, *Recovery and Restoration of Damaged Ecosystems*.[32] Across the Atlantic, a North Atlantic Treaty Organization (NATO) conference at Reykjavik, Iceland, in July 1976 produced *The Breakdown and Restoration of Ecosystems*.[33] By 1980, Bradshaw and M. J. Chadwick had produced *The Restoration of Land*, essentially a textbook waiting for the emergence of an academic discipline.[34] A theme that runs throughout these works is that "[l]and [and, presumably, also aquatic habitats] is not a resource which automatically renews itself like rainfall and sunlight. . . . [T]he profligate days are over. We have to be prepared to restore exploited land to a condition approaching its original biological potential."[35] In 1981 the University of Wisconsin—Madison Arboretum began publishing *Restoration and Management Notes*, the first periodical dedicated to the emerging field; in 1999 it changed its name to *Ecological Restoration*, which remains what it is called today. The Society for Ecological Restoration (SER) was founded in 1988; its journal, *Restoration Ecology*, began appearing in 1992. *Restoration ecology*, as the discipline dedicated to ecological restoration, thus emerges as an organized discipline at roughly the same period as conservation biology.[36] There was—and, to some extent, there remains—tension between the two fields with conservation biologists fearing that the acceptance of restoration as a goal would diminish sup-

[30]Anonymous [1971].
[31]See [Cairns *et al.*, 1971; Hill, 1971; Curry, 1971; Linton and Cooper, 1971].
[32]Cairns *et al.* [1977].
[33]Holdgate and Woodman [1978].
[34]Bradshaw and Chadwick [1980].
[35]Bradshaw and Chadwick [1980, p. 2].
[36]For the history of conservation biology, see [Sarkar, 2005]. The crucial date was 1986 when the Society for Conservation Biology and its journal, *Conservation Biology*, were both founded.

port for protecting whatever relatively intact ecosystems that remained.[37] By and large, during the late 1980s and early 1990s, the two disciplines evolved independently.[38]

However, in spite of its increasing popularity, the use of the term, *restoration*, remained fluid. In *The Breakdown and Restoration of Ecosystems*, the editors identified restoration with rehabilitation. In their textbook, Bradshaw and Chadwick explicitly chose a broad interpretation:

> *Reclamation* is often used where some new use of the land will be involved; *rehabilitation* is sometimes confined to improvements of a visual nature. *Restoration* may be used only where land is to be returned to its former use and *renewal* or *redemption* may be used in a form that enables flexibility in planning its re-use. The term *revegetation* is generally confined to situations where the original vegetation has been destroyed and its reappearance in some form is to be encouraged. In this book *restoration* is used as blanket term to describe all those activities which seek to upgrade damaged land that has been destroyed and to bring it back into beneficial use, in a form in which the biological potential is restored.[39]

Note that there is no insistence on achieving similarity to some past historical state or trajectory even though such a more restricted construal of *restoration* is noted as a possibility. Eight years later, Cairns produced a similarly general definition: "restoration ecology is the full or partial placement of structural or functional characteristics that have been extinguished or diminished and the substitution of alternative qualities or characteristics than the ones originally present with the proviso that they have more social, economic, or ecologic value than existed in the disturbed or displaced state."[40]

Once again there is no endorsement of historical fidelity. Nor is there much concern for forging a universally acceptable definition.[41] Nevertheless, by 1988, with the founding of the SER, definitional controversies began to get explicit attention. Between 1988 and 1994 the SER produced three official definitions of ecological restoration.[42] It was during these discussions that fidelity to a historical past began to become central to how restoration was conceived: restoration consisted of aiding and abetting a system's return to that past. In 1992, the Committee on Restoration of Aquatic Ecosystems appointed by the United States National

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[37] Cairns [1988].

[38] See, however, [Cairns, 1986; Janzen, 1988] for early attempts to bridge the divide. An influential later attempt is [Hobbs and Norton, 1996].

[39] [Bradshaw and Chadwick, 1989, pp. 2–3]; italics as in the original. Note how this definition implicitly invokes a reference state criterion (upgrading degraded land) and a dynamic criterion (restoration of biological potential).

[40] Cairns [1988, p. 3].

[41] Hobbs and Norton [1996] even argued for the irrelevance of attempts to define *restoration* universally.

[42] Higgs [2003, p. 102].

Research Council produced a report on the state of aquatic restoration science.[43] During the course of its meetings, the committee canvassed the literature for suggestions on how the term should be defined. It came up with 60 definitions.[44]

Meanwhile, the SER produced two more official definitions based on recommendations of internal Science and Policy Working Groups, in 1996 and 2002.[45] The former effort arose from a symposium held during the 1994 annual SER conference at East Lansing, Michigan. The resulting definition was complicated: "Ecological restoration is the process of assisting the recovery and management of ecological integrity. Ecological integrity includes a critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices."[46] What the second sentence means is less than clear. It is oddly allusive which is particularly strange for a definition: we are told what ecological integrity includes but not what it is (which would require letting us know what it also excludes) or how it should be operationalized.

In any case, the explicit reference to ecological integrity was viewed by many SER members as involving unwarranted abstraction. Moreover, most SER members in the 1990s were North Americans and, perhaps expectedly, the explicit recourse to management and the reference to cultural practices both fell afoul of the authority that the wilderness model of nature protection has long had among North American environmentalists.[47] Consequently, the 2002 definition was shortened and side-stepped all three issues: "Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed."[48] Given the status of the SER (now SER International) as the only major collective organization in the field, presumably this is the definition most practitioners would endorse in principle, whether or not their practices followed its precepts carefully.

Note how this definition takes for granted that we know what it means for an ecosystem to be degraded, damaged, or destroyed. In practice, this is sometimes simple: in the Balcones Canyonlands National Wildlife Refuge we know when King Ranch bluestem has replaced native grasses, though we have no idea which grasses were originally present and when. But most decision scenarios are even worse.

Ecosystems are not static entities: they evolve over time and natural evolution may well result in changed, perhaps even simplified, communities (for instance, when a plant community proceeds towards a climax association through competitive exclusion). What counts as a degraded, damaged, or destroyed ecosystem

[43] MRC [1992].

[44] John Cairns Jr. (personal communication, 2007). Cairns Jr. chaired the NRC committee in question.

[45] Higgs [2003, p. 96].

[46] Higgs [2003, p. 109]. Note that this definition is quite different from the one that came out of the 1994 meeting itself. That definition is discussed by Jackson *et al.* [1995]: "Ecological restoration is the process of repairing damage caused by humans to the diversity and dynamics of indigenous ecosystems."

[47] For more on the wilderness model, see the papers collected in Callicott and Nelson [1998] and Sarkar [1998; 1999].

[48] Higgs [2003, p. 110].

can often only be determined only if a goal (typically involving what are called *reference conditions* in the literature) has been specified. The specification must be done with care: returning to the Refuge, by and large, we will never know the original vegetation cover for most areas. Moreover, the unwanted spread of Ashe juniper thickets, which must be controlled, does not obviously "look" like anything other than prospering forest recovery. The 2002 SER definition skirts the issue of specifying goals but it is unavoidable.[49]

Not requiring explicit attention to the goal of restoration also differentiates the 2002 SER definition from the earlier National Research Council definition which was, in glaring contrast, focused entirely on the goals: "*restoration* is defined as the return of an ecosystem to a close approximation of its condition prior to disturbance. In restoration, ecological damage to the resource is repaired. Both the structure and the function of the ecosystem are recreated. . . . The goal is to emulate a natural, functioning, self-regulating system that is integrated with the ecological landscape on which it occurs."[50]

In an obvious advance from purely goals-based and purely process-oriented definitions, in 1996, Cairns and Heckman included both process and goal in their influential review of the state of the field.[51] The 2002 SER definition was an unfortunate step backward. Even more importantly, cultural practice plays no role in the 2002 SER definition (unlike the 1996 SER definition). This is particularly surprising because of how restoration had been conceptualized by almost all practitioners. Unlike, for instance, biodiversity conservation, which was also emerging to the forefront of environmental movements during this period, restoration was widely perceived as socio-cultural practice. As early as 1988 Janzen had argued for the *biocultural* restoration of tropical habitats as a means to conserve biodiversity.[52] Within the SER, Cairns had long advocated restoration as including an *ecosocietal* process, arguing that "the field requires the input and cooperation of society to be successful"; restoration included "the process of reexamining human society's relationship with natural systems so that repair and destruction can be balanced and, perhaps, restoration practices ultimately exceed destructive practices."[53] Among other benefits, Cairns and Heckman argued that restoration practices may enable urban communities to establish worthwhile relationships with natural systems.[54]

For all its beguiling simplicity, the frailties of the 2002 SER definition are thus obvious and perhaps beyond easy repair. More recently, Higgs has returned to

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[49]Somewhat strangely, in stark contrast to the definition itself, the SER primer, specifying how restoration should be practiced, paid full attention to the determination of reference conditions. See SERI [2004]. (Note that the definition being criticized in the text was also presented in this primer.)

[50]NRC [1992, p. 18]; italics as in the original.

[51]Cairns and Heckman [1996].

[52]Janzen [1988].

[53]Cairns [1995, p. 9]. A similar point is argued by Jackson *et al.* [1995] in their commentary on the 1994 SER definition.

[54]Cairns and Heckman [1996, p. 175]. A similar point was emphasized by Hobbs and Norton [1996, p. 95].

the 1996 SER definition and has insisted on both historical fidelity and ecological integrity as part of the definition of restoration.[55] Higgs is on solid ground in endorsing ecological integrity: some such criterion is invoked in most typical restoration efforts, at least in North America. For instance, even the Refuge Vision Statement of the Balcones Canyonlands National Wildlife Refuge claims that its management plan is designed to be "consistent with overall conservation of regional ecological integrity."[56] Cultural practice—more specifically, participatory or "focal" practice—is also part of what Higgs views as good restoration though it is not part of his definition. Higgs also endorses what he calls "wild" design, and we will return to wildness as a natural value in Section 6. Higgs has provided the most sustained philosophical discussion of ecological restoration to date and, in what follows, we will use his definition. Though the next section will note some problems with the concept of ecological integrity, the real target of this analysis is the reliance on historical fidelity, whether it has adequate normative justification as a goal of social (including ecological) policy. Note that, whereas ecological integrity disappears from the 2002 SER definition, that definition implicitly endorses historical fidelity since it requires *recovery* to the state of the habitat before it was degraded, damaged, or destroyed.[57] A critical evaluation of historical fidelity is thus not marginal to how ecological restoration is practiced today. The interesting question of *why* historical fidelity crystallized in the foreground of the mental maps of restorationists, especially in the 1990s, will be left for exploration on another occasion.

4 DOUBTS ABOUT INTEGRITY

Similarly, an adequately detailed evaluation of the concept of ecological integrity will also be left for another occasion. Recall how, in Section 1, we characterized ecological restoration as having two goals specified by a dynamic criterion and a reference state criterion. Note that this formulation is fully general: no matter how habitat reconstruction is construed, it will involve some dynamic criterion and some reference state criterion. What is at stake is which criteria should be chosen. Ecological restoration, as we have seen, uses historical fidelity to identify the desired reference state and we will examine that criterion in Section 5. Here we note a few worries about the use of ecological integrity as the dynamic criterion. Since these worries are fairly general, we will not distinguish between biological, ecosystem, and ecological integrity. The main problem has been that ecological integrity has never been fully satisfactorily defined.[58] Nor is there any compelling

[55] Higgs [2003, p. 122].

[56] USFWS [2001, p. 1]. This is just one of two references to ecological integrity in the two-paragraph statement.

[57] The SER primer also uses historical fidelity to define reference conditions and explicitly gives "prominence to the historically rich idea of 'recovery'" [SERI, 2004, p. 2].

[58] See, for instance, the desultory discussion of De Leo and Levin [1997], which remains one of the more elaborate attempts at providing a comprehensive account of integrity.

reason to expect that there is some "natural" definition of the concept. Like the concept of minimum viable population in conservation biology,[59] that of biological integrity was introduced by legislative fiat, when the United States Federal Water Pollution Control Act Amendments of 1972 stated that their objective was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[60] It is far from clear what the legislation meant by "integrity" beyond the quality of water and the reliability of its supply. However, that did not prevent the concept's scientific reification. In 1975, the United States Environmental Protection Agency's Office of Water and Hazardous Materials sponsored what it envisioned as a comprehensive symposium on the "integrity of water."[61] By this point integrity had already come to be reinterpreted as a property of any ecosystem, rather than of a water body. At the symposium, Cairns defined "[b]iological integrity ... as the maintenance of the community structure and function characteristic of a particular locale or deemed satisfactory to society"[62] and made an elaborate attempt to operationalize and quantify the concept. A few years later, Karr and Dudley produced a similar definition without the societal component: "the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region."[63]

There have been many variations on these themes[64] though, in recent years, there has been a tendency to produce multi-faceted measures of integrity without explicitly defining the concept.[65] Proponents have sometimes even argued for the replacement of biodiversity by biological integrity as a policy goal.[66] There have also been critics.[67] The point, though, is that there is no reason to suppose that a concept introduced by legislative fiat will necessarily be conceptually linked to (presumably more empirically-based) scientific concepts in such a way that it can be operationalized and quantified for scientific use. Perhaps the SER members had a point when they objected to the use of integrity in the 1996 SER definition of ecological restoration (see Section 3.) Given the relative lack of success with using ecological integrity, it may well behoove us to shift attention to what the concept was supposed to do for us to see if it may not be replaced by some other dynamic criterion.

For Higgs, ecological integrity is a metaphor.[68] It is related to ecological health but different from it and preferable because it is supposedly easier to define and more closely related to historical fidelity. Unfortunately, this is too vague to get

[59] For more on this example, see [Sarkar, 2005].
[60] See Agee [1977, p. 3].
[61] Ballentine and Guarraia [1977].
[62] Cairns [1977, p. 171].
[63] Karr and Dudley [1981, p. 56].
[64] See, for instance, [De Leo and Levin, 1997; Parrish *et al.*, 2003].
[65] See, for instance, [De Leo and Levin, 1997; Harwell *et al.*, 1999].
[66] Angermeier and Karr [1994].
[67] Sarkar [2005] has objected that the definitions of Karr and Dudley [1981] and Angermeier and Karr [1994] cannot be operationalized.
[68] Higgs [2003, pp. 122–124].

us very far. There is more help from those who have explicitly connected integrity to a variety of ways in which a potentially related concept, ecological stability, has been explicated within ecology. These include resistance, resilience, perturbation-tolerance, persistence, constancy, and reliability.[69] Of these, resistance (the inverse of the extent of change induced by a given perturbation on the system) and resilience (the rate at which a system recovers from a perturbation) have been most commonly invoked. For instance, Cairns took resistance to be an important component of integrity in his first attempt to quantify the concept.[70] Resilience is a goal that has repeatedly been emphasized in the literature[71] though Higgs has argued that resilience may be in conflict with what he takes to be integrity.[72] To the extent that each of these concepts measure the extent or way in which an ecosystem may avoid collapses, they are all singly or jointly appropriate as a dynamic criterion.

A theme that runs through many of these discussions is that, ultimately, the more self-sustaining a system is after reconstruction, the more successful the reconstruction has been.[73] In what follows we will take self-sustainability to be the dynamic criterion to judge success, and leave open the question of its relationship to integrity. The answer to that question will depend on how integrity is defined. We will also leave for another occasion the relation of self-sustainability to any of the ecological stability concepts mentioned above. Note, though, that self-sustainability will be a matter of degree. It can be quantitatively assessed through a variety of social and biological measures of intervention in the system: the cost of intervention, the amount of biomass introduced or removed, and so on, each of which provides an estimate of how much effort is required to maintain the system along the preferred trajectories.

Success does not necessarily require achieving a high degree of self-sustainability.[74] But it helps: if we acknowledge that success is a matter of degree, higher self-sustainability is associated with a higher degree of success. Returning, as usual, to the Balcones Canyonlands, the hope is that repeated prescribed burning will establish native grasses to such an extent that burning may eventually be reduced. Similarly, old growth Ashe juniper and oak forests, once established, will likely require little continued intervention to be maintained as good habitat for the Golden-cheeked Warbler. Both of these will constitute a high degree of self-

[69]For more on these concepts, see [Justus, 2007; Sarkar, 2007].

[70]Cairns [1977, p. 180].

[71]See, for instance, [Hobbs and Norton, 1996; Pavlik, 1996; White and Walker, 1997].

[72]Higgs [2001, p. 169]: "some integral ecosystems have relatively low levels of resilience, which explains their fragility and rarity."

[73]The significance of self-sustainability was noted by the United States National Academy of Science as early as 1974 in its attempt to characterize rehabilitation [US-NAS, 1974].

[74]Self-sustainability makes Higgs [2003, p. 169] uncomfortable because it seems to imply that restored systems are better if there is no human involvement in them. But this is only true if the notion of "self" excludes humans, that is, the systems are conceptualized without humans as components of them. No such assumption is being made in the text. Intervention, then, does not refer to all human interactions with the system; rather it refers to the additional interactions that are required beyond what was customarily achieved.

sustainability. In contrast, Black-capped Vireo habitat will probably have to be indefinitely created in order to prevent succession leading to mature Ashe juniper forests unsuitable for this species. In this case self-sustainability will be low but that is no indication of failure: rather, success or failure will depend on whether Vireo populations recover to safe levels.

5 PROBLEMS WITH FIDELITY

Let us now turn to the arguments for historical fidelity. Fidelity is not supposed to be interpreted as the exact replication of past ecosystems (which would be practically impossible in almost all cases). Rather, it means approximate achievement of past reference conditions with contextual factors, such as the information or resources available, determining what degree of approximation is sufficient. The strongest arguments for fidelity—perhaps not unexpectedly—are due to Higgs who has been developing a rationale for it for decades. For Higgs, historical fidelity or "historicity" is central to restoration. In his words: "In reviewing why historicity might be important, I have grown resolute in the belief that it is indispensable for theory and practice, no matter how social winds sculpt what we currently think ecological restoration is."[75] Since Higgs has produced the only sustained philosophical discussion of historical fidelity, this section focuses on his work.[76] He presents three explicit arguments for historicity: "nostalgia and the knowledge this brings of a better past; the capacity to create continuous stories that inform our understanding of a place, or what I call narrative continuity; and depth of time."[77] But behind these lurk what may be a much deeper and troubling worry: if we abandon history, "we will be giving in too much to the capricious nature of contemporary judgment."[78]

We will return to the worry about caprice later. Let us begin with nostalgia. Higgs is not naïve enough to think that the past was simply better than the present because it is the past. Rather:

> Why are we drawn to history in the first place? What is it about historical conditions that compels so much attention? ... The most obvious answer would be that the past is, or was, somehow better. But it is not better in any simple way, at least for most people. Past

[75]Higgs [2003, p. 157]. In its context in Higgs' original discussion, this quotation does not appear arrogant though it may seem that way out of context. This point is important to note because ecological restorationists (like biodiversity conservationists) have sometimes been accused of arrogance [Gobster, 2000].

[76]But Higgs is by no means alone, at least in North America, once we move beyond philosophers and include the broader restorationist community. For instance, the van Diggelen *et al.* [2001] embrace historical fidelity as the goal of "true" restoration though they are willing to use the term more broadly than Higgs. Allison [2004] at least partly endorsed historicity because it is supposed to define who we are.

[77]Higgs [2003, p. 132]. Allison [2004] also seems to rely on narrative continuity for the same reason.

[78]Higgs [2003, p. 131].

> landscapes ... represent a simple, less hurried time when fidelity to a more organic way of life was visible. But nostalgia ignores much of the difficulty of times past, and countervailing historical accounts are necessary for balance. In any case, the point is that the past shows an alternative sometimes better, model. [Higgs, 2003, p. 143]

But, if the past is only *sometimes* better, fidelity to the past should not be a *necessary* requirement imposed on all attempts to reconstruct habitats. We should only do so in those cases when we know that the past—some particular historical ecosystem—really is better. But what matters, then, are the criteria which make this historical ecosystem better. These criteria are what is normatively relevant as we decide what to do with habitats. Historical fidelity becomes merely a tool towards these other ends. Fidelity becomes relevant *only* if these other ends cannot be achieved without it or if these ends have some necessary connection with history.

In particular, if historical ecosystems are important because they provide a model of systems which are self-sustaining without intrusive human management, the relevant criterion is self-sustainability which, as we noted in Section 4, is reasonable as a dynamic criterion. Self-sustainability has no necessary connection with history. The past may even stand in the way of achieving the goal of self-sustainability. Recall, for instance, the much-studied case of the Mayan use of resources, an example that is compelling because of North American restorationists' infatuation with the pre-Columbian past. Assuming that the environmental resource overconsumption model of the classic Mayan collapse (roughly 800–900 C.E.) is at least partly correct,[79] the Mayan management of land hardly provides a model we should imitate. Moreover, there is much else in that Mayan past which we presumably would not want, for instance, the oppressive social hierarchy and the penchant for human sacrifice. In cultural contexts closer to us, presumably we would not be nostalgic over slavery, the domination of women, or colonialism; or for the Holocaust, even though the Nazis are supposed to have taken excellent care of nature. If we were designing a restoration plan for some place in the Deep South of the United States, historical fidelity to an environment (productive cotton fields) that was maintained through slavery hardly seems an ethically justifiable goal especially if, along with Higgs, we view our goals to include social processes along with ecological ones. Not everyone wants nostalgia.

A subsidiary theme, preference for simplicity, also runs through Higgs' defense of nostalgia. At one point, he writes: "most of us of a certain age can look back in one way or another to an era of greater integrity and simplicity";[80] shortly, thereafter, he explains his nostalgia: "the past [was] a simpler time with less fragmentation and a greater flow of ecological processes."; this is the "elegance" he longs for.[81] Attractive, though this may seem, it does not push the argument any further. If it is ecological simplicity that is at stake, we are faced with the problem

[79] See [Shaw, 2003].

[80] Higgs [2003, p. 144].

[81] Higgs [2003, p. 145]. Note that neither simplicity, nor the flow of ecological processes or elegance, has any necessary connection with history.

that, typically, damage to an ecosystem consists of the simplification of ecological communities. This cannot be what we are looking for, and the greater flow of ecological processes that Higgs calls for takes us back to self-sustainability and, perhaps, integrity, not historical fidelity through nostalgia. But Higgs, as noted earlier, is careful not to make a sharp distinction between ecological and cultural processes—restoration, for him, is as much a cultural process as an ecological one. But cultural simplicity also cannot be a reasonable goal in many, perhaps most, circumstances. Human well-being may well depend on the complexity of daily cultural interactions. Take the much-retold story of the Ik who were displaced from their traditional lands to create the Kidepo Valley National Park in Uganda.[82] Social life disintegrated and social processes were simplified as living became no more than a struggle for individual daily survival. There are many other such instances. Perhaps the only interpretation of simplicity that is defensible is one which refers to a situation in which human interactions with nature were less mediated by technology—recall Higgs' reference to "a more organic way of life." But, even then, what really matters is not the past, but rather a particular relation between humans and the rest of nature that may well be best achieved by imagining a new vision for the future. It does not *require* historical fidelity.

Turning to narrative continuity, Higgs argues that narratives associated with places make them meaningful to people when they come to value those places for what they are and, perhaps more importantly, what they may become through restoration efforts. Since human aspirations are central to the pursuit of all reconstructionist efforts, narratives may often provide important encouragement. But do narratives need historicity? It is easy to see that historical continuity helps narrative construction: a story about the past is a narrative about a place. But what does not follow is either that this is the only way in which a narrative can be associated with a place, or even that the past must dominate narrative construction. Nor does it follow that narratives, understood in the traditional sense of a story, are required to foster habitat reconstruction. People plant gardens, and this activity may well generate community and foster stewardship of habitats including the biota present on them. In Texas, the Parks and Wildlife Department (TPWD) encourages local residents to plant and maintain native vegetation, install birdbaths and ponds, and create other structures for use by wild animals.[83] The goal of this "Wildscapes Program" is to provide places for birds, small mammals, and other wildlife to feed and drink, escape from predators, and raise their young. Creating these "backyard habitats" is also easier than maintaining conventional lawns. Most native plants are hardy and drought-resistant and thus need little or no water or other care. These plants are also more tolerant of native insects and diseases. TPWD has a Texas Wildscapes certification program and, along with

[82]See [Turnbull, 1972]. However, some of Turnbull's conclusions have since been challenged—see [Heine, 1985].

[83]Damude *et al.* [1999]. When people create such non-historical natural habitats, they are often willing to defend them against restorationists—recall the controversy over attempted restoration in the Chicago metropolitan area in the mid-1990s when restorationists wanted to transform woodlands into shrublands and tall grass prairie guided by history [Gobster, 2000].

the National Wildlife Federation, also administers a Best of Texas Backyard Habitats certification program. To support the Program, biologists associated with the TPWD organize workshops and teach "wildscaping" courses in cooperation with local organizations. Texas Wildscapes is more than a backyard program. Besides homes, it embraces community parks, business offices, churches, and schools. Thousands of Texans participate in it and there is a tangible sense of community among those who attend the workshops and other events. Budgetary constraints have prevented TPWD from monitoring the program with quantitative evaluations of success though anecdotal reports suggest that such efforts are achieving some state-wide success.[84] It is a matter of taste whether we would want to call participation in such programs as embedding places in narratives. Either way, historical fidelity has nothing to do with the story.

The depth of time is supposed to be related to narrative continuity: "Continuity points to *time depth* ... [which] is the reach of history, the amount of time, and also the engagements that form between people and place over that interval."[85] But this claim does not yet provide a rationale for endorsing historical fidelity. Rather, establishing a relevant connection between fidelity and time depth is based on a claim about rarity: "The older an ecosystem is, judging by the length of time without major human simplification of processes and patterns, typically the rarer it is. Depth depends on rarity: they are really two sides of the same coin."[86] But, now the crucial normative criterion is rarity. Higgs explicitly notes that there is no necessary connection between rarity and history: "it is possible for something to be rare without being historical. . . . Rarity depends often on depth of history, but it can stand alone, too."[87] What we should conclude is that historical fidelity may sometimes guide us towards what is really important: increasingly rare ecosystems. Fidelity, once again, is a means, not an end. There is no reason to suggest that historical fidelity can never be important. In some circumstances trying to recapture a past use of the land may be an important social value: those are the situations when reconstruction may reduce to restoration provided that ecological integrity, rather than some other goal, is also taken as the dynamic criterion (see Section 7). But there is no reason to accept that achieving historical fidelity should be a *necessary* component of every habitat reconstruction plan. However, before we fully accept this conclusion, let us turn to what may be the most compelling argument for taking history seriously: if we do not, Higgs says, we may fall prey to the caprices of the present.

There are two responses to this argument. First, what we do with habitats is guided by our values including our dynamic criteria and other natural values that may serve as reference state criteria (see Section 6). As we shall see in Section 7, not much room is left for caprice after we negotiate through these values.

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[84] Alford [2005]. Note that many restorationists have emphasized the role of explicit monitoring in restoration efforts [Hobbs and Norton, 1996]. The TPWD can be faulted on this ground [Margules and Sarkar, 2007].

[85] Higgs [2003, p. 154]; italics as in the original.

[86] Higgs [2003, pp. 154–155].

[87] Higgs [2003, p. 155].

Rather, the real problem is that there may be few truly different alternatives left once we implement all these values. Suppose, for instance, that habitats must be managed for biodiversity, productivity, and ecosystem services. Our choices are more likely to be overdetermined rather than left to the whims of contemporary caprice. Second, concern for historical fidelity hardly provides relief from possible caprice. There is no single past state for any ecosystem. Which period of time should we aspire to? In the so-called Old World (essentially, Africa, Asia, and Europe) this question cannot conceivably have a non-controversial answer. In Australasia and the Americas, the state of the land before European contact is often taken to be the ideal. In the Americas, at least, the authority of this view has largely come from the now antiquated belief that the First Nations did not actively manage much of the land.[88] Once we recognize the extent to which the First Nations constructed the ecosystems that were invaded by the Europeans, 1492, besides the introduced alien species, has no compelling ecological significance in spite of all its devastating moral, cultural, political, and social consequences.

Here comes space for caprice. In August 2005, with much aplomb, a group of scientists and a right-wing political activist announced a new *restoration* plan for North America.[89] They proposed to introduce and promote species closely related to North American megafauna from the late Pleistocene era, some 13,000 years ago. Partly the goal was to prevent Asian and African species, such as the Asian ass (*Equus hemionus*), Przewalski's horse (*Equus przewalskii*), Bactrian camel (*Camelus bactrianus*), African cheetah (*Acinonyx jubatus*), African elephant (*Loxodonta africana*), Asian elephant (*Elephas maximus*), and lion (*Panthera leo*), from becoming globally extinct. But the alleged real purpose was to restore the evolutionary potential of North American biota, and to assuage the guilt that the authors felt for the allegedly anthropogenic extinction of North American megafauna: "humans were probably at least partly responsible for the Late Pleistocene extinctions in North America, and our subsequent activities have curtailed the evolutionary potential of most remaining large vertebrates. We therefore bear an ethical responsibility to redress these problems."[90]

Within the conservation biology community, the proposal was largely greeted with derision mainly because it was designed (probably unintentionally) to turn conservation attention and resources away from countries of the South in which the megafauna were under serious threat.[91] The ethics of reallocating such resources away from the South, particularly from sub-Saharan Africa, had escaped the attention of the plan's proponents while they explored their moral responsibilities to long-extinct species. Biological critics pointed out that we really do not know

[88] The antiquated view has been repudiated by a vast body of historical research during the last 25 years, starting with the pioneering work of Cronon [1983]. Mann [2005] provides an engaging synthesis of what has recently been learnt of pre-Columbian America.

[89] Donlan *et al.* [2005; 2006]. The recognizable right-wing political activist was Dave Foreman—for more on Foreman's politics, see [Lee, 1995]; see, also, [Sarkar, 2005].

[90] Donlan *et al.* [2005, p. 913].

[91] Chaptron [2005].

what such massive introductions of exotic species would do to habitats.[92]

Nor do we know enough about the Pleistocene era to judge whether we can recover the ecological and evolutionary potential of that distant era.[93] Critics also pointed out that there were plenty of native North American species that were under threat and would benefit from "re-wilding" through their reintroduction to parts of their historical habitat from which they had been extirpated. These include the bison (*Bison bison*), pronghorn (*Antilcapra americana*), elk (*Cervus elaphus*), jack rabbit (*Lepus townsendii*), black-footed ferret (*Mustela nigripes*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), swift fox (*Vulpes velox*), various ground-dwelling squirrel species (*Spermophilus* spp.), and prairie dog species (*Cynomys* spp.). Moreover, the puma (*Puma concolor*) is a much closer relative of the long-extinct American cheetah (*Miracinonyx trumani*) than the African cheetah, and to prefer the latter to the former for re-introduction is biologically bizarre. Its proponents had never calculated the cost of the plan, and the resources that would be necessary even to initiate it would probably be much better deployed elsewhere. The Pleistocene rewilding proposal is a superb exercise of caprice, motivated in part by its proponents' fascination with megafauna which reflects Northern values of the moment. The point is that a deep concern for historical fidelity provided no guard against caprice.

We should also not forget that attempts to establish historical fidelity are typically inordinately expensive and, in most cases, impossible to achieve because of incomplete information and the uncertainty of ecological predictions.[94] It is expensive because data acquisition and the reconstruction of what the past looked like usually takes extraordinary effort. Sifting through historical archives for old photographs and records takes time. For many parts of Earth no such records exist even within historical time. Reconstructing the past from palynological records is even more difficult and expensive. Efforts spent in these direction may well be better spent in acquiring land and reconstructing it into something better. Moreover, even if we manage an accurate reconstruction of what some habitat was at a specified time in the past, we have no way to reliably predict how it would have changed under different management conditions. Let us also not forget that establishing historical fidelity would likely harm species that have come to benefit from the changes in the land—recall the discussion of the Goldencheeked Warbler in Section 2. We need a broader conception of natural values. Finally, in an era in which largely irreversible global change, in particular, climate change is beginning to dominate ecological changes in habitats, returning to some historical conditions may have little correlation with what can survive into the future.

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[92] For a review of the criticisms, see [Rubenstein *et al.*, 2006].

[93] Leave aside the problem that *ecological potential* and *evolutionary potential* are rather vague terms, never clearly defined, let alone operationized for scientific use. There is little that is of positive value in Donlan *et al.*'s [2005; 2006] proposal.

[94] Note that Higgs [2003, p. 129] explicitly acknowledges and emphasizes these problems.

6 NATURAL VALUES

Natural values are those that promote the welfare of non-human biota or enhance aspects of the physical environment that are not the result of continuing human action.[95] They are human values, just like historical fidelity. There are two false contrasts that may potentially be read into this characterization and it will be useful to reject them explicitly. (1) No *type*-distinction is being endorsed between humans and the rest of nature. Rather, an operational distinction is being made between values on the basis of the extent to which they promote the flourishing of non-human features of the environment. The pursuit of ecologically destructive mineral extraction, for instance, oil extraction in the Niger Delta by Shell and other multi-national companies, falls at one end of the spectrum, in this case accompanied by gross human rights violations.[96] Planting native wildflowers along highways as, for instance, promoted by the Texas Department of Transportation since 1932,[97] falls at the other end. (2) It is not being suggested that reconstruction should be directed towards "pristine" aspects of the environment bereft of anthropogenic influence. That would be self-contradictory: reconstruction is human activity. Rather, this formulation is designed to reflect the view that anthropogenically modified parts of the physical environment—Mount Rushmore, for example—embody natural values to diminishing extents as they are increasingly modified. Finally, natural values are not the only ones that are normatively well-grounded. Reconstruction efforts must negotiate with other, sometimes even more ethically compelling, demands on habitats, for instance, even potentially ecologically destructive resource extraction if that is the only way in which (human) individuals can survive.[98]

Environmental ethicists have unfortunately spent far more time on how natural values should be founded than on finding out what they are, and how they interact with each other. Consequently, any attempt to produce a list must be exploratory and subject to critical future refinement. We have already encountered ecosystem integrity, resistance, resilience, perturbation-tolerance, persistence, constancy, and reliability as possible goals of habitat reconstruction in Section 4. Each of these individually, or in combination with any of the others, can serve as the dynamic criterion in reconstruction efforts. Historical fidelity, however, may be replaced by a reference state criterion reflecting other natural values. Even a perfunctory

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[95] The qualification "continuing" is needed because some physical features we now value may once have been partly created or influenced by human actions. Presumably the actions of even our recent evolutionary ancestors should be regarded as not different from, say, those of beavers (*Castor canadensis*) building dams across landscapes.

[96] See [Okanta and Douglas, 2001] for a book-length discussion of the environmental and social problems created by oil extraction from the Niger Delta of Nigeria.

[97] See [Markwardt, 2005]. This program has been remarkable successful, at least at the sociocultural level, by increasing appreciation of wildflowers in Texas.

[98] Luckily, from this ethical perspective, especially in the South, where most poverty is concentrated, except in some urban slums, the most economically dispossessed groups are those that rely most heavily on continuing resource production from natural ecosystems—the groups from the Niger Delta provide a good example [Okanta and Douglas, 2001].

examination of reconstruction efforts produces five broad categories.[99]

1. *Contextualized Biodiversity*: That biodiversity is a desirable natural value probably no longer needs any defense—it has become part of our cultural landscape, at least in Northern societies. But not all components of biodiversity are equally appropriately promoted in all contexts. Rather, the biodiversity that it is appropriate to pursue on a given land- or seascape must be locally contextualized. At least five criteria have been used for this purpose and each has a sound normative grounding.

    1.1. *Vulnerability*: In the United States, where much of biodiversity conservation is practiced under the aegis of the ESA, it requires no further argument to defend the use of the vulnerability of taxa as a criterion for contextualizing biodiversity. Beyond the United States, the Red List of at-risk species maintained by the World Conservation Union (IUCN) is widely used in a similar way.[100] The normative argument for focusing on vulnerable taxa is straightforward: if preventing the disappearance of biota is one of our goals, we have no option other than to focus on vulnerable biota (and the depth of focus should track the degree of vulnerability) because these are the ones most likely to disappear without our attention. There is room for argument as to whether it is wise social polity to allocate limited resources on biota that may disappear even in spite of our best efforts, as opposed to allocating them to biota with better prognoses. But that does not affect the appropriateness of using vulnerability as a criterion for contextualizing biodiversity in habitat reconstruction efforts. In the Balcones Canyonlands National Wildlife Refuge, much of management focuses on the Golden-cheeked Warbler and Black-capped Vireo precisely because they are endangered. Management consists as much of creating new suitable habitat as protecting existing such habitat. In the rest of the Canyonlands, attention is equally appropriately focused on the other at-risk species discussed in Section 2.

    1.2. *Rarity*: Rare biota deserve our attention. Most often rarity is taken to be an indicator of potential vulnerability and, in such cases, this criterion is not entirely independent of the last one and has the same normative grounding. But rare biota may also deserve attention because they draw our attention to unusual features of our habitats (including the complexity of interactions between biota) and encourage us to think harder about them. Rarity is also widely used in habitat management efforts. Returning to the Refuge, rare endemic invertebrates (even though they are not recognized to be endangered or threatened) are protected in the cave systems; similarly rare plants (including the

[99] Note that these categories are not supposed to be independent of each other. The order in which they are presented is not intended to suggest any judgment about their relative importance.
[100] Margules and Sarkar [2007].

Shooting Star, Sycamore-leaf snowbell, and Texabama croton) are also protected to the extent possible.

1.3. *Environmental Suitability*: It makes sense to support a species at a locale if that locale, in terms of its environmental features, is particularly suitable for that species. Moreover, environmental suitability makes success more likely when biota have to be established (or re-established) on any habitat. These may appear to be prudential claims but prudence is not entirely normatively irrelevant. Consequently, this criterion is an obvious one to use when determining what is appropriate biodiversity to promote in any context. Finally note that this criterion can be used by itself or in conjunction with any of the others to prioritize biota for attention at any locale.

1.4. *Proximity to Native Range*: By and large, it should be fairly uncontroversial that local species should get preference over non-local ones when all other things (for example, vulnerability or rarity) are equal. Nevertheless, this criterion has generated a fair amount of controversy during the last few decades, among other reasons because on many occasions it may reflect socio-cultural prejudices such as nativism rather than any genuinely natural (or ecological) value. Arguably "alien," "invasive," and so on, are human terms which become metaphors when introduced in ecological contexts. Chew and Laubichler have emphasized the problems with interpreting nature in such human terms.[101] Nevertheless, there is ample evidence that non-native taxa often pose serious threats to the persistence of native taxa and, on that ground alone, they should be discouraged.

1.5. *Cultural Role*: In many societies, biota play significant cultural roles. Species have totemic value, religious significance, are used for hunting or other forms of recreation, and so on.[102] In many regions of Earth, entire biologically rich habitats have been preserved or even created as sacred groves.[103] In the North, charismatic species have long been used to identify which habitats to protect or enhance. Sometimes large amounts of resources have been dedicated to a single charismatic species. For instance, in Texas, the Aransas National Wildlife Refuge was set up in 1937 to protect just one species, the Whooping Crane (*Grus americanus*).[104] Managing that Refuge has involved modifying thousands of hectares of habitat to make it suitable for just this species which, for some, became North America's "symbol of conservation."[105]

[101] Chew and Laubichler [2003a; 2003b]; for a response, see [Perry and Schueler, 2003].
[102] The literature on this topic is vast. Jardine *et al.* [1996] provides a useful entry. Berkes [2008] is an extensive discussion of sacred ecology.
[103] For African examples, see [Sheridan and Nyamweru, 2008]; for India, see [Malhotra *et al.*, 2007].
[104] McNulty [1966].
[105] Pratt [1966].

Those who see a sharp nature-culture divide may be uncomfortable with cultural role as a natural value but, then, they would presumably be equally uncomfortable with conscious anthropogenic habitat modification in the first place. The point is that these cultural choices satisfy the definition of natural value with which we started.

2. *Productivity*: Enhancing the productivity of ecosystems (typically measured in biomass produced) has often been a goal for the reconstruction of habitats for a variety of reasons including improving ecosystem services and enhancing environmental security, both of which we discuss below.[106] Here we focus on agriculture and aquaculture. Reclaiming land for agriculture has traditionally been an important rationale for reconstructing habitats particularly after they had reached the end of their useful "non-natural" lives, for instance, as mines or quarries.[107] In the United Kingdom in the 1940s, Hall even went as far as to identify land reconstruction largely with "farming in the national interest."[108] Similarly, aqueous bodies can be managed for fish and other useful taxa, often ultimately intended for human consumption. Increasing productivity includes plantation forestry to ensure or increase supplies of fiber, fuelwood, and other wood products. These are all valid natural values to be pursued, once again "natural" for those who do not demand a sharp nature-culture divide.

3. *Ecosystem Services*: Agriculture and aquaculture do not exhaust the services that natural habitats provide. In general, forests may serve as sinks for carbon and other products of natural or anthropogenic processes. Constructed wetlands can be used to remove pollutants from water.[109] The Millennium Ecosystem Assessment listed more than twenty ecosystem services besides productivity (of food, fuelwood and fiber) and environmental security (see below).[110] These include other provision resources (fresh water, biochemicals [including natural medicines and pharmaceuticals], ornamental resources, and genetic resources), regulating services (air quality maintenance, climate regulation, disease regulation, water regulation, water purification, pollination, and biological control), cultural services (including spiritual and religious services, recreation, aesthetic services, inspirational services, education, conveying a sense of place, cultural heritage, and social relations), and supporting services (soil formation and nutrient services besides primary production). Once again, these are all valid natural values, at

[106] Productivity has sometimes been controversial as a goal of restoration (*sensu stricto*)—see, for example, [Jackson *et al.*, 1995]. However, this does not detract from its being a natural value. Hobbs and Norton [1996] defended its use as a goal of restoration broadly construed, in effect, reconstruction.

[107] See, for example, [Konke, 1950; Smith *et al.*, 1971; Bradshaw *et al.*, 1982].

[108] Hall [1942].

[109] See, for example, [Samecka-Cymerman *et al.*, 2004].

[110] MEA [2003, pp. 53–60]. The list that follows excludes those services that are also classified here under primary productivity and environmental security.

least for those who do not demand a sharp nature-culture divide.

4. *Environmental Security*: A particularly important type of service provided by natural habitats is security against weather-related harm.[111] In general, wetland creation can be used for flood reduction. In particular, reconstructing mangroves along coasts can guard against the effects of storms.[112] These are included by the Millennium Ecosystem Assessment as regulating services.[113] Reconstructing habitat for wildlife so as to minimize human-wildlife contact may reduce the risk of zoonotic disease transmission to humans which has increased significantly since 1940.[114] Once again, these are all valid natural values for those who do not demand a sharp nature-culture divide.

5. *Wild Nature*: Finally, we turn to wild nature, a constant preoccupation of Northern environmentalists, and often equally strongly criticized by environmentalists from the South.[115] Two positions should be distinguished, (i) the pursuit of wild nature as a goal, along with other natural and socio-cultural goals, and (ii) the situation when wild nature trumps these other goals because of the presumed intrinsic value of wild nature (or some other such reason). While the second position may well be ethically bankrupt,[116] the first suffers from no such problem unless we assume that there is some necessarily problematic aspect to any appreciation of wild nature. To the best of our knowledge, such a case has never been successfully made. Note that the pursuit of wild nature as a natural value has been interpreted in two strikingly different ways.

    5.1. *Wildness*: Wildness refers to unpredictability, in nature it refers to the ability of a system to generate surprises and, perhaps, evade human control. It promotes humility in humans, demanding caution in how they modify the rest of nature. In the context of the United States, this may well be what Thoreau had in mind when he promoted wildness. Higgs is also one of those who embraces wildness as a goal of restoration.[117] Normative justifications for the pursuit of wildness range from attempts to attribute intrinsic value or internal agency to natural systems[118] to forging anthropocentric arguments for the value of wildness. The latter arguments often involve the power of wildness to transform felt preferences of individuals.[119]

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[111] Mea [2003, p. 58].
[112] Ewel *et al.* [1998].
[113] Hey and Phillipi [1995].
[114] Jones *et al.* [2008].
[115] For a spectrum of views, see [Callicott and Nelson, 1998; Sarkar, 1998; 1999].
[116] Sarkar [1999; 2005] makes this argument.
[117] Higgs [2003].
[118] Sarkar [2005] surveys this literature.
[119] For more on such transformative values see [Norton, 1987; Sarkar, 2005].

5.2. *Wilderness*: Finally, we turn to what is perhaps the most contested goal in environmental philosophy, wilderness, typically construed as habitats which were not molded by human actions and which do not admit permanent human presence.[120] If we take seriously the requirement that wilderness habitats be ones that are not molded by human actions, then the idea of reconstructing wilderness *by our actions* is self-contradictory. But, by now, we know that the typical exemplars of wilderness almost anywhere in the world are habitats which were often actively created by traditional inhabitants whose memory has been erased, typically by Northern colonists.[121] Consequently, we may reject the "no human molding" requirement, and may argue for the creation of wilderness defined by no permanent human presence. The normative justification of such a goal will be similar to that of wildness, either based on intrinsic value or on transformative value, in the latter case typically relying on the sublime power of solitude to transform human minds and preferences.

We now have a tentative catalog of natural values which may be used to replace historical fidelity as the reference state criterion in attempts to reconstruct habitats. It is time to lay down the reconstructionist agenda.

7 THE RECONSTRUCTIONIST AGENDA

After all this preparation, framing the reconstructionist agenda is rather straightforward. As in Higgs' definition of ecological restoration, there are two criteria to be satisfied: a dynamic criterion and a reference state criterion. Earlier we suggested self-sustainability as the dynamic criterion and left open its relation to various concepts of ecological integrity and stability. We will not pursue this issue further here though it merits more discussion. Suffice it to note that some such criterion of success is necessary in order to ensure that the end point of a habitat reconstruction effort is not ephemeral, that is, it will have some degree of permanence. It is not being assumed that the reconstructed habitats will require no future human intervention at all. But it is being assumed that the less intervention that is required to maintain a reconstructed habitat, the greater the success of a reconstruction plan.

Turning to the reference state criterion, for habitat reconstruction, any of the natural values listed in the last section may be used singly or jointly to specify what that criterion is. For the reasons discussed in Section 5, what we aspire to make in a habitat should not be constrained by a deification of history. The

[120] The classic critique is Guha [1989]. Callicott and Nelson [1998] collect many of the more important contributions from both sides of the debate. Sarkar [1999; 2005] provides a scientific critique of wilderness preservationism. Woods [2001] attempts a systematic overview.

[121] For the United States, see, in particular, [Cronon, 1983; 1996]. For rainforests, see [Willis *et al.*, 2004]. Sanderson *et al.* [2002] provide a global assessment.

broad spectrum of natural values that reconstruction embraces is also consistent with the practice of much of what is called restoration today. Historical fidelity is not adopted as a goal in some circumstances because the historical past of a locale cannot be reconstructed with the data that are available.[122] In the Balcones Canyonlands and, in fact, throughout the Edwards Plateau, we know little of the vegetation cover even a hundred years ago, let alone earlier.[123] There is obviously nothing normatively suspect in using other natural values in such cases. But, in many circumstances, the natural values of Section 6 are pursued because they are deemed worthwhile themselves even when ensuring historic fidelity is feasible and what is being practiced is called *restoration*. These efforts are still called *restoration* presumably because of an assumption that what is really at stake is that some dynamic (functional) or reference state attribute of the system is being *restored* to a more desirable state. In the Balcones Canyonlands National Wildlife Refuge, prescribed fire is used to *restore* grasslands and shrublands in many areas that may or may not have been such communities in the first place. *Restoration* is also used to describe the creation and maintenance of habitat for the endangered birds (the Black-capped Vireo and the Golden-cheeked Warbler) wherever it is appropriate (that is, there is suitable environment, embodying yet another of the natural values of Section 6) whether or not these areas were historically occupied by these species.[124]

Is there room for any choice? Suppose we worry about only one natural value: vulnerability. In the Balcones Canyonlands, as noted in Section 2, ensuring enough adequate habitat for just these two endangered bird species requires a careful balancing act because they have radically different habitat requirements. What about caprice? It is hard enough even to ensure that just two endangered species recover. Our choice is over-determined—mostly we wish we had more leeway in what often turns out to be a frustrating search for a reasonably optimal habitat management plan. If more than one natural value from our list is used to devise a reference state criterion, there is scope for even more conflict: values may be incompatible with each other.

Enhancing productivity may conflict with promoting native species. Promoting native species may conflict with promoting rare or vulnerable species. Miscellaneous ecosystem services may be incompatible with each other, for instance, recreation with water purification.[125] And so on. Interpreting each value as a criterion to be satisfied, negotiating such potential conflicts will typically require formal multi-criteria analysis (MCA) for complex decisions. MCA techniques, mainly developed by the decision analysis community over the last few decades, are already routinely used in systematic conservation planning for biodiversity

[122]Higgs [2003, p. 129] also notes this difficulty.
[123]Fowler [2005]; Sarkar [forthcoming]. The historical record is so sparse that the prospect of ever reconstructing this history is negligible.
[124]USFWS [2001, p. 6].
[125]Kareiva *et al.* [2007] have also emphasized the importance of explicitly analyzing tradeoffs between ecosystem services.

conservation.[126] They are yet to be systematically used in restoration ecology but their availability indicates that there is no fundamental problem with using a wide spectrum of potentially incompatible values for habitat reconstruction.

From this perspective, ecological restoration (*sensu stricto*, that is, with historical fidelity as the reference state criterion) is just one special form that habitat reconstruction can take. So is each of reclamation, regeneration, rehabilitation, revegetation, and so on. What is being embraced here is a broadening of the goals of what we should do with habitats to enhance the natural values embodied in them. But, obviously, as was emphasized earlier, this does not amounts to any rejection of ecological restoration as one possible goal for habitat management. It depends primarily on whether historical fidelity is deemed appropriate as a social goal. But it also depends on whether adequate data are available to reconstruct the past with any degree of certainty, whether it is even possible to return a system at least approximately to that past state, and whether it is worth the cost. There is probably no general answer to these questions. Any answer will depend on the particular ecological and social context of formulating policy for a habitat.

Note that the discussion of Section 6 did not explicitly list historical fidelity as a natural value even though that is the reference state criterion for ecological restoration. However, since historical fidelity was treated as an alternative to the natural values of Section 6, there is an implicit suggestion that it, too, is a natural value. However, there is an equally compelling sense in which the pursuit of any history is a cultural value. We will leave open the question as to whether historical fidelity is a natural or cultural value, or both. For the argument of this paper, it does not matter. We have not assumed a sharp nature-culture distinction and, in any case, the practice of reconstruction (or even restoration *sensu stricto*) does not require an answer to this question.

Finally, let us return for one last time to the question whether jettisoning historical fidelity will lead to caprice. After all, this was the deepest worry raised by Higgs' defense of historical fidelity (see Section 5). We saw in Section 5 that requiring fidelity is no guard against caprice. Moreover, if we take seriously both whatever dynamic criterion we adopt, and a reference state criterion that incorporates the natural values of Section 6, habitat reconstruction may well turn out to be as, if not more, restrictive than many traditional forms of ecological restoration (*sensu stricto*). Caprice requires underdetermination of choice by criteria. In the case of restoration, underdetermination occurs, among other ways, because of the freedom to decide what historical period should provide the reference state. In contrast, our earlier discussion of caprice in this Section shows that the natural values of Section 6 will typically leave no such freedom.

In reconstruction we may have more reason to worry about too many constraints rather than the possibility of caprice.

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[126] Moffett and Sarkar [2005] review the literature; for illustrations, see [Moffett *et al.*, 2006; Margules and Sarkar, 2007].

8 CONCLUSIONS

Where does all this leave us? We have two options.[127] If we construe ecological restoration narrowly, requiring both ecological integrity and historical fidelity, then restoration will very often not be the most normatively salient goal for how we choose to treat our habitats. If we construe restoration more broadly, as originally championed by Bradshaw and Chadwick,[128] then restoration would both describe much more of what is practiced as such. But we may then confine historical fidelity to those cases in which it is deemed appropriate as a cultural value. Meanwhile our goals can be established using a wide spectrum of natural values, including those discussed in Section 6. What we do at the Balcones Canyonlands National Wildlife Refuge when we create and maintain habitat for the Black-capped Vireo or the Golden-cheeked Warbler does count as restoration. If we choose to encourage the spread of rare plants on the Refuge, we are still doing restoration.[129] In other words, *restoration*, broadly construed is no different from what we have been defending as *reconstruction*.

By itself, the terminological issue is probably not important.[130] But whether we endorse historical fidelity as our sole reference state criterion does matter, both for practice and in theory. It matters for practice because of two reasons. (1) It restricts the range of natural values that can be used to guide what we do with our habitats. None of the values discussed in Section 6 would be legitimate goals to pursue. (2) It makes the reconstruction projects expensive, probably quite often impossible. It requires us to expend resources to determine what the past condition of a system was. In many cases, for instance, in the Balcones Canyonlands, this is virtually impossible. Perhaps even more importantly, it matters in theory because of four reasons. (1) It deifies nostalgia. Ecologically this may be illegitimate if the past state of a system has little relevance to what it would have become today even without anthropogenic change. Given the largely irreversible global changes that have lately been taking place, including climate change, it is difficult to see how the past, especially the distant past, can have any relevance except in very rare cases. Socially and culturally, nostalgia is equally problematic because the past may well not be something we wish to encounter again. (2) It is arbitrary because any past period that we choose to replicate is just one of an indefinite number of possibilities. For instance, the much-used pre-Columbian past in the Americas is arbitrary and based on a demonstrably false assumption that the First Nations of the continent did not actively manage their natural environments. (3) It is also arbitrary because we have no reliable method of knowing what any past state would have evolved into under a different interaction regime with humans. Theoretical ecology simply does not have the tools to make accurate predictions of

[127]These are essentially the same options also demarcated by [Higgs, 2003, p. 129].
[128]Bradshaw and Chadwick [1980].
[129]This expanded definition is also endorsed elsewhere, for instance, by Hobbs and Norton [1996] and Gobster [2000].
[130]This point was forcefully argued by Hobbs and Norton [1996]; for a response, see [Higgs, 2003, pp. 94–95].

that kind. (4) It assumes without argument that the other natural values discussed in Section 6 are not important, or at least they are trumped by historical fidelity. As we saw in Section 6, there is a multiplicity of natural values and each of these values is normatively well-grounded. Individuals and groups will disagree about these values. Public discussions to plan for the future are inevitable, and desirable in democratic societies. Invoking nostalgia (and historical fidelity) amounts to foreclosing such debates about nature by fiat, ruling against a continued public cultural discussion on what is appropriate in human interactions with the rest of nature.

In Section 5 we saw that every argument for historical fidelity turned out ultimately to be based on some other end: simplicity, an "organic" relation to habitat, rarity, and so on. Fidelity was at best a means to an end, and this end had no necessary connection to history. What this paper as a whole is intended to have shown is that we should move beyond historical fidelity and, as a result, beyond ecological restoration construed narrowly. Rather we should embrace the full spectrum of reconstructionist practices that have a much longer history than what ecological restoration became when historical fidelity emerged as its sole reference state goal. The practical problems with historical fidelity give us prudential reasons for rejecting its authority. Even more importantly, while framing policies for the management of habitats, the theoretical problems show that the pursuit of historical fidelity *alone* as such a goal is normatively misguided. Luckily, in practice, much of what is called ecological restoration is not construed narrowly and this critique leaves it untouched. Perhaps it even helps establish good normative foundations for these practices by delving into all the natural values we can justifiably embrace as we manage our land- and seascapes.

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