Degraded or just different? Perceptions and value judgements in restoration decisions

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An underlying premise of ecological restoration is that it focuses on the recovery of degraded systems. While this is an apparently straightforward aim, there is in fact considerable variation in how the term “degraded” is defined, used and assessed. In addition, there is a notable subjective component to decisions regarding what is degraded and what isn’t, and this often relates to the values and goals being considered. There is likely to be little argument over highly degraded systems where damage and loss of valued characteristics are evident. But where system change is less stark and the changes have mixed benefits and disbenefits, the decision on whether the system is degraded and hence in need of restoration becomes more difficult. As systems continue to change in the face of ongoing climate, land use and other environmental changes, decisions become more difficult regarding which systems are degraded and which are merely different from what was there before. Difference does not necessarily equate to degradation. Effective use of scarce management resources relies on an improved ability to openly debate and resolve such issues.

Key words: degradation, ecosystem change, non-native species, novel ecosystem

Conceptual Implications

• As ecosystems change in response to altered biophysical settings, increasing consideration of “difference” as well as “degradation” is needed to inform restoration and management decisions.
• Different motivations, levels of resourcing, and scales will determine what type and intensity of intervention is considered appropriate.
• Open discussion of the perceived values of systems in different states will facilitate effective decisions in restoration and management.

Introduction

There has been increasing discussion in the scientific literature, popular press and internet blogs on the topic of whether any ecosystem can or should be a valid candidate for restoration, or whether some systems may have changed to such an extent that restoration is no longer a practical, or desirable, goal. In particular, the term “novel ecosystem” has been used to describe systems that comprise new mixtures of species (resulting from species invasions and local extinctions) and/or new abiotic settings (resulting from climate and land use change) (Hobbs et al. 2006, 2009, 2013). However, this has led some commentators to question the validity of the term and particularly the argument that some systems may not be amenable to standard restoration practices or that restoration may not even be appropriate. For instance, Clewell and Aronson (2013) suggest that “… many so-called novel ecosystems are really impaired ecosystems that can be recovered by ecological restoration in the holistic sense of the term” (p 245). In response to the suggestion that a framework that includes novel ecosystems provides the opportunity to prioritize actions and decide when it is impossible or impractical to restore a system, Murcia et al. (2014) state that: “All ecosystems should be considered candidates for restoration, regardless of the requisite resources.” Other commentators suggest that the introduction of terms such as “novel ecosystem” has important implications for how society and policy makers view systems and the capacity for restoration: for instance Woodworth states: “to write about a ‘novel ecosystem in a new ecological world order’ creates a very different impression, and a very different call to action, than to write about a ‘chronically degraded ecosystem in a new ecological world disorder’” (Paddy Woodworth Newsletter: August 2015 http://us5.campaign-archive2.com/?u=db8ea84381fc9156638b9dbcf&id=7a1e070537&e=81c3d92967; accessed 24 Nov 2015).

It is certainly valuable to examine and use terms and language carefully, and hence I wish to explore the above commentary in more detail. In particular, I wish to question the assumption that novel ecosystems can always be viewed as “degraded.” Instead, I posit that some altered systems are simply different from what was there before, and hence are not necessarily degraded and in need of restoration.
Restoring Degraded Ecosystems

The commonly accepted definition of restoration comes from the Society for Ecological Restoration (SER) primer: “Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed” (Society for Ecological Restoration International Science & Policy Working Group 2004). As Stanturf et al. (2014) state: “The starting point for restoration is determined by the definition of degraded, because restoration is the reversal of degradation.” The SER primer carried on to state: “The terms degradation, damage, destruction, and transformation all represent deviations from the normal or desired state of an intact ecosystem. The meanings of these terms overlap, and their application is not always clear.” The primer indicates that “degradation pertains to subtle or gradual changes that reduce ecological integrity and health.” To clarify what is meant by this, the primer states: “The terms ecosystem integrity and ecosystem health are commonly used to describe the desired state of a restored ecosystem. Although some authors use the terms interchangeably, they are distinctly different in meaning. Ecosystem integrity is the state or condition of an ecosystem that displays the biodiversity characteristic of the reference, such as species composition and community structure, and is fully capable of sustaining normal ecosystem functioning. Ecosystem health is the state or condition of an ecosystem in which its dynamic attributes are expressed within ‘normal’ ranges of activity relative to its ecological stage of development.”

Clewell and Aronson (2013) further state: “We refer to ecosystems as being intact or whole if they exhibit integrity and health. Conversely, degradation, damage, destruction, and transformation all represent deviations from the normal or desired state of an intact ecosystem” (p 10). They define degradation as: “The incremental and progressive impairment of an ecosystem on account of continuing stress events or punctuated minor disturbances that occur with such frequency that natural recovery does not have time to occur” (p 258). However, they also define impairment somewhat circularly as “The state or condition of an ecosystem or landscape that has been degraded, damaged, or destroyed as a result of extraordinary impact or disturbance from which spontaneous recovery to its former state is unlikely, at least in the short term” (p 260).

Several questions arise from these statements and definitions. Particularly, how are the “normal or desired state” and “normal ecosystem functioning” to be ascertained, and who decides on this? And how are ecosystem integrity and health to be measured, and against what? In other words, how do we, in reality, decide what’s degraded (or impaired) and what isn’t?

How is “Degraded” Defined?

To seek assistance in clarifying these issues, I examined how degradation is defined in recent textbooks, policy documents, and papers in the literature. The definitions focused variably on ecosystems, forests, land, or soil. These are listed in Table 1. Others are discussed in more detail by Stanturf et al. (2014) in relation to forest restoration, and these authors also provide a perspective on the large range of forest attributes, degradation agents, and potential degradation indicators considered in the sphere of forest degradation.

The SER primer definition proved to be the vaguest of the definitions provided, while most of the definitions focused more on functional and ecosystem service aspects rather than compositional change per se. Among the various textbooks available currently, Greipsson (2010) and Galatowitsch (2012) did not provide a definition of degradation, and the array of other books and sources provide a rich array of different definitions with differing emphases. This appears to corroborate a comment by Plesník et al. (2011), who concluded that: “Although environmental/ecosystem degradation has been one of the most often used subjects in environmental protection and nature conservation and management, a precise definition has been lacking both in science and policy. ‘Degraded ecosystem’ has been understood and consequently recognized more intuitively than based on the well-developed criteria applied during ecosystem assessment.”

Lamb and Gilmour (2003) discussed the inherent subjectivity in the way degradation is perceived, and pointed to the problems associated with whether a particular system or site should be viewed as degraded: “Badly degraded sites are easy to recognize…. Degraded forests have lost much of their productivity and biodiversity as well as many of the ecological goods and services they once provided. But are less disturbed sites degraded? In fact, just when does a forest become ‘degraded’? What is the threshold condition beyond which degradation occurs?” They went on to consider how different people with different perspectives or management goals will have different views on this: “The Food and Agriculture Organization of the United Nations (FAO) has defined forest degradation as changes within a forest that affect the structure and function of the stand or site and thereby lower its capacity to supply products or services. In practice, however, degradation is much more subjective; people can have quite different perceptions about the same landscape. For example, a wildlife enthusiast may see an impoverished forest, while a forester sees a productive forest regenerating after logging. Similarly, a forester may see a degraded forest while a shifting cultivator sees a piece of prime agricultural land. Almost inevitably, ‘degradation’ is in the eye of the beholder. Not all landholders or managers will necessarily agree that degradation has occurred; even if they do, they may disagree about the most appropriate response. These contrasting perceptions make it hard to define and measure degradation, and to obtain definitive statistics on its regional, national or global scale” (Lamb & Gilmour 2003). Adding different cultural contexts into this mix adds further complexity (e.g. Burger et al. 2008).

Degraded or Not?

Hence, in summary, the definitions of degradation vary considerably and relate to different features of ecosystems depending on the policy and management context. This context also determines how different people perceive and interpret
Table 1. Definitions of the term “degradation” taken from a range of current textbooks, policy documents, and selected literature. The selection is designed to be illustrative rather than comprehensive.

| Definition | Source |
|------------|--------|
| Degradation pertains to subtle or gradual changes that reduce ecological integrity and health (see text for further discussion). | Society for Ecological Restoration International Science & Policy Working Group (2004) |
| The simplification and loss of biodiversity caused by disturbances that are too frequent or severe to allow natural ecosystem recovery. Degradation generally reduces the flow of ecosystem goods and services. | Howell et al. (2012) |
| The simplification and loss of biodiversity in an ecosystem caused by disturbance factors. Different “degrees of ecosystem degradation” can be distinguished depending on whether or not one or more thresholds of irreversibility have been crossed. In cases of severe and prolonged ecosystem disturbance, natural ecosystem recovery is sometimes no longer possible in a relevant or “reasonable” period of time. Degradation, resulting from various factors, including climate change and extreme events, as well as human activities, generally reduces flows of ecosystem goods and services. | van Andel and Aronson (2012) |
| The incremental and progressive impairment of an ecosystem on account of continuing stress events or punctuated minor disturbances that occur with such frequency that natural recovery does not have time to occur. | Clewell and Aronson (2013) |
| Land degradation refers to any reduction or loss in the biological or economic productive capacity of the land resource base. It is generally caused by human activities, exacerbated by natural processes, and often magnified by and closely intertwined with climate change and biodiversity loss. | UN Convention to Combat Desertification (UNCCD) (2014), http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/Land_Degrad_Neutrality_E_Web.pdf |
| Soil degradation is defined as a change in the soil health status resulting in a diminished capacity of the ecosystem to provide goods and services for its beneficiaries. Degraded soils have a health status such that they do not provide the normal goods and services of the particular soil in its ecosystem. Land degradation has a wider scope than both soil erosion and soil degradation in that it covers all negative changes in the capacity of the ecosystem to provide goods and services (including biological and water related goods and services—and also land-related social and economic goods and services. | FAO, http://www.fao.org/soils-portal/soil-degradation-restoration/en/ |
| Ecosystem degradation: a persistent reduction in the capacity to provide ecosystem service. The degradation of an ecosystem service is: For provisioning services, a decreased production of the service through changes in area over which the service is provided, or decreased production per unit area. For regulating and supporting services, a reduction in the benefits obtained from the service, either through a change in the service or through human pressures on the service exceeding its limits. For cultural services, a change in the ecosystem features that decreases the cultural benefits provided by the ecosystem. | Millennium Ecosystem Assessment (2005) |
| Land degradation implies reduction of resource potential by one or a combination of processes acting on the land. These processes include water erosion, wind erosion, and sedimentation by those agents, long-term reduction in the amount or diversity of natural vegetation, where relevant, and salinization and sodication. | United Nations Environmental Program (UNEP) (1992) |
| Environmental degradation is the deterioration of the environment through depletion of resources such as air, water, and soil; the destruction of ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable. | Johnson et al. (1997) |
| Forest degradation is broadly defined as a reduction in the capacity of a forest to produce ecosystem services such as carbon storage and wood products as a result of anthropogenic and environmental changes | Thompson et al. (2013) |
| Land degradation can be considered in terms of the loss of actual or potential productivity or utility as a result of natural or anthropic factors; it is the decline in land quality or reduction in its productivity | Eswaran et al. (2001), http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_054028 |
presence/absence and levels of degradation. An important question is how the definitions translate into what happens in practice.

Decisions to “restore” areas to alternative ecosystem types are often taken on the basis of perceptions of what was there, or what “should have been” there, rather than a consideration of the relative value of the existing system and the costs versus benefits of the restoration. As Lamb and Gilmour (2003) point out above, the decision may be relatively straightforward for highly degraded systems, but becomes less clear in less extreme cases. The question of what is perceived as degradation becomes particularly complex in the context of cultural landscapes. Cultural landscapes require the continuation of particular forms of management, without which they change into other ecosystem types—this applies equally in both the old and new worlds, where thousands of years of human use have shaped landscapes through cultivation, pastoralism, fire, selective planting of favored species, and so on. Although this influence is obvious in some places, particularly in many parts of Europe, the importance of human management in shaping ecosystems in the Americas, Australia, and elsewhere is only recently being fully recognized and is the subject of ongoing debate and controversy (e.g. popular accounts by Mann (2005) and Gammage (2011)). A failure of European colonial science and governance to correctly interpret the human influence on landscape has led to interesting misdiagnoses regarding the condition of ecosystems. For instance, Fairhead and Leach (1996) discuss the case of small islands of dense forest in a savannah landscape in Guinea that were interpreted by colonial scientists and policy makers as the last relics of a once more extensive forest that was degraded by human use. In fact, detailed historical, social, and ecological analysis indicated that the exact opposite was true: the forest patches were created by human management around villages in an otherwise more sparsely vegetated landscape.

Misinterpretation of the condition of ecosystems continues, even today. Recent studies point to the danger of unintended consequences arising from inappropriate labeling of lands as “degraded,” both at a regional and global scale. Analysis by Veldman et al. (2015) showed that, at the global scale, the Atlas of Forest and Landscape Restoration Opportunities (World Resources Institute 2014) misclassified 9 million km$^2$ of grassy biomes as “deforested” or “degraded” and therefore providing “opportunities” for forest restoration. Clearly, care is required in interpreting calls for restoration that might involve significant modification of existing ecosystems and the loss of their biodiversity and services.

In cases where ecosystems change due to the alteration or cessation of traditional management practices, should the resulting systems be viewed as degraded? Or are they simply different from what was there before? The key consideration at the centre of this question is how much relative value people place on the past and current systems: degradation is in the eye of the beholder, and may relate to loss of, or change in, particular ecosystem characteristics—for instance, functional aspects such as water and nutrient flows or compositional aspects such as species compositions and vegetation structure. So, when a patch of land is currently a forest but is known historically to have been a grassland, is the forest a degraded state in need of restoration? Conversely, if a current heathland may once have been a forest (e.g. Hobbs 2008), is it a degraded state or something worth conserving in its own right? And if the heathland starts spontaneously changing to a forest when fire and grazing management change, should that be viewed as degradation in progress?

In an increasingly anthropogenic world in which rapid and ongoing environmental change is evident, these questions become more frequent and prevalent. Complexity is added when the changes involve the development of new species combinations and configurations and landscapes become complex mixes of patches in differing degrees of alteration (Hobbs et al. 2014). Several commentators have recently reiterated the fact that ecosystems and biotic assemblages have always been, and continue to be, dynamic entities both temporally and spatially (e.g. Jackson 2013; Handel 2015). The current situation differs mainly in terms of rate of change, with many regions experiencing rapid change in both environmental conditions and biotic composition, mainly due directly or indirectly to human activities (e.g. Ellis 2015).

Although change is a perennial and natural phenomenon, changes in ecosystems are perceived through value-based filters, even if the values involved are recognized implicitly rather than explicitly. Some changes undoubtedly have negative impacts on ecosystem characteristics. Where these altered characteristics have clear effects on human society as a whole (for instance flood mitigation or fire risk), then it is clear that the system can be relatively unambiguously labeled as degraded. Similarly, few people would argue with the observation that a highly salinized lake (formerly freshwater) is degraded (Standish et al. 2014). In other cases, however, the effects may be mixed or neutral, impacting characteristics that are valued by some members of human society but not by others, or altering the suite of characteristics in ways that subtract from some values but add to others. Here, assigning the label “degraded” becomes more problematic. For some members of society, changes such as increased abundances of non-native species may be perceived as entirely negative. However, the same change may be perceived differently or even go unnoticed by other members of society. A high profile recent example of this is Mt Sutro in California, where local residents are opposed to proposed “restoration” of cloud forest dominated by non-native eucalypts (Venton 2013).

Reconciling these differences is currently a topic of major concern in restoration and conservation biology. Taking invasive species as an example, there has been a polarized debate between those that see all non-native species as actual or potential threats that require management action and those that see pragmatic reasons to view some non-native species as either benign or beneficial (Davis et al. 2011; Simberloff 2011, 2014; Shackelford et al. 2013; Thompson 2014). The label “non-native” has many of the same issues attached to it as the label “degraded,” and there is more ambiguity surrounding the term than has previously been apparent (examples in the study of Thompson 2014; Pauli et al. 2015). Many restoration efforts are focused wholly or partially on removal of invasive species, often rightly so because of the well-evidenced impacts
of these species on the native ecosystem. In some cases, however, impacts are assumed rather than confirmed, and the species concerned are now an established part of the local ecological community. Hence their removal may either be unjustified or unwise, particularly where the methods of removal have potential flow-on ecosystem effects, and may waste scarce management resources. There is also the possibility that removal of the species will have unintended adverse effects on other species or system properties (e.g. Sheehan & Ellison 2015). Advising on this dilemma, Clewell and Aronson (2013) suggest, on the one hand, that restorationists should “take courage from the numerous successful campaigns undertaken to control or eradicate harmful invasives, and carry on in the same spirit, with all the means at our disposal,” but on the other hand that they “may have to practice triage to decide which invasives can be effectively extirpated and which are too well established to even bother” (p 45–46). In the face of such conflicting advice, open discussion is required on whether the presence of a non-native species automatically renders a system degraded and hence in need of restoration. More generally, there is a pressing need for an ongoing examination of what types of intervention are justified under an array of different circumstances (Hobbs et al. 2011).

Conclusion
It is becoming increasingly important to examine the premises behind restoration efforts and ask the difficult question of whether observed changes are resulting in a system that is degraded or merely different. Despite ongoing debate about appropriate goals for restoration in the twenty-first century, little thought has been given to the underlying assumption that altered systems are automatically to be perceived as degraded. Difference per se is not necessarily a symptom of degradation, particularly if the change from the previous system has neutral, mixed, or positive impacts on ecosystem characteristics that are valued. Graham and Hicks (2015) go further to suggest that, for coral reefs, different ecosystem configurations may actually prove to be useful management goals in the face of ongoing rapid change and that these may prevent actual degradation from irreversibly damaging the systems in question.

Rather than arguing over the validity of different approaches to ecosystem restoration and management, restoration scientists and practitioners could benefit from a step back that allows a broader perspective on how systems are changing and where efforts are best placed to allow effective management into the future. This will likely include a recognition of the plurality of situations and motivations involved in restoration (Higgs et al. 2014). There will continue to be a place for efforts to restore one or two hectares of land and, where there is access to the required financial and other resources or large volunteer groups, the aspiration may be to go as far as possible toward fully restoring system properties. On the other hand, efforts to overcome degradation on a much greater scale and having fewer resources to do so are less likely to be concerned with some aspects of ecological restoration. Although the term “restoration” has been used in the context of broad-scale restoration efforts, ecological restoration, in the sense used by SER, will likely be uncommon over most of this area, at least in the immediate future.

This does not mean we should “lower the bar” and entirely forgo the original SER goals but that restorationists might give more attention to developing a wider range of interventions that recognize the trade-offs needed to match the degree of degradation, the aspiration of landholders and the actual capacity (or willingness) of these landholders to do anything (bearing in mind that many people living in degraded landscapes live in poverty). Restoration can legitimately focus on restoring functionality or ecosystem services rather than just the original biodiversity.

On top of these broad differences in motivations for undertaking restoration are the more contentious concerns around what to do about changed or changing systems that can be valued in their own right. An array of recent contributions aim to address this concern in some way: for instance, value considerations in novel ecosystems (e.g. Thompson & Jackson 2013), managing whole landscapes consisting of patches in an array of different degrees of modification (Hobbs et al. 2014), and comprehensive ecological restoration (Suding et al. 2015). Indeed, any ecosystem decision framework needs to embed a process of deliberation in restoration decision making (e.g. Higgs & Hobbs 2010). In other words, decision processes increasingly need to recognize there are varying perceptions of degradation that must somehow be resolved if effective conservation, restoration and intervention are to be undertaken in the future, and that the same decision will not necessarily be taken everywhere. This short article has enunciated some of the issues surrounding this: the challenge now will be to forge a way forward that tackles these issues in a constructive and effective manner.

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