Novel ecosystems and the emergence of cultural ecosystem services

Marcus J. Collier

Abstract

Many landscapes are severely depleted of ecosystem services, especially industrial ones. Yet, abandoned and, in some cases, regenerating areas are often situated within a wider cultural landscape. With minimal further disturbance these 'novel ecosystems' have the potential for recovering some of the ecosystem services that were removed or impeded during and after human management activities, especially cultural services. Novel ecosystems are anthropogenic landscapes that cannot be returned to their original ecological status. However, some novel ecosystems may provide ecosystem services that were minimal or perhaps absent from their original form. This presents a dilemma for policy makers and planners, who now strive to meet societal expectations to restore ecosystems and recapture lost services. It is especially poignant when seeking to develop policy prescriptions that operationalise cultural ecosystem services into planning and design. Little is known of the potential for drawing on a novel ecosystem framework when developing prescriptions for these planners and policy makers. This short communication re-visits earlier social-ecological research in a post-industrial landscape to illustrate how a novel ecosystem may offer insight into operationalising ecosystem service policies in damaged and recovering landscapes. Because novel ecosystems have stimulated debate and disagreement among ecologists, this paper offers a new perspective on the issue. Drawing on research into post-industrial peatlands, this paper identifies a timeline for the recovery of some ecosystem services in novel ecosystems, including some that were absent from their original state.

Key words: Cultural Landscapes; Ecosystem Services; Novel Ecosystems

Introduction

Novel ecosystems are a new concept in restoration ecology. Novel ecosystems are believed to contain species assemblages that have no historic comparisons due to species distribution alteration, climate and land use change and an emerging acceptance of newer values and functions in habitats, ecosystems and landscapes. A novel ecosystem is a "system of abiotic, biotic and social components (and their interactions) that, by virtue of human influence, differ from those that prevailed historically, having a tendency to self-organise and manifest novel qualities without intensive human management" (Hobbs et al., 2013, p. 58). This has been challenged recently since human influence can cover a wide range of impacts over different timescales (Morse et al., 2014). Regardless of specificities, it is expected that novel ecosystems will become increasingly relevant in policy and practice, as social and environmental stress changes over time (Lindenmayer et al., 2008), necessitating a new approach to landscape management (Seastedt et al., 2008). This will necessitate a deeper understanding of ecological and cultural services in altered and/or abandoned spaces. Between 26% and 36% of the ice-free portion of the Earth is altered and/or abandoned (Perring and Ellis, 2013), so novel ecosystems are pervasive and increasing. Rehabilitation or restoration to an 'original' state may be futile, with Hobbs et al. arguing that to attempt such restoration may squander precious conservation resources (2009).

Continual land-use change in Europe has given rise to a plethora of novel ecosystems and a vast cultural (or anthropogenic) landscape, and this has had a significant effect on ecosystem services (Maes et al., 2011). This has brought about a sharper focus on those services that are presumed to exist at the various social-ecological interfaces within cultural landscapes. It is emerging that highly altered landscapes, such as those containing novel ecosystems, may provide such services (Tengberg et al., 2012; van Berkel and Verburg, 2014). While it has been shown that landscapes of conservation importance can provide regulating and cultural ecosystem services when compared with areas outside conservation (Maes et al., 2012), no quantification research has so far be carried out with respect to novel ecosystems and ecosystem services. Given that they are human constructs, novel ecosystems, such as those that emerge upon the cessation of extractive mining for example, may be ideal locations to put into practice the type of participatory landscape management that answers the call for a multi-functional response to land use change (Antrop, 2006). Multi-functionality is seen as a desirable response to the goal of sustainability of rural livelihoods (von Haaren, 2002), and there is a concerted effort to find mechanisms to bring this into reality (Dolman et al., 2001). Following recent calls for exploring the links between ecosystem services and cultural landscape interactions (Schaich et al., 2010) this short communication discusses the potential for novel ecosystems for operationalising socio-cultural ecosystem services. This potential is

exemplified using post-industrial peatlands, since they are common throughout Europe and because industrial processes make it unlikely that such landscapes can be restored to their original status within a satisfactory policy timeframe (Collier and Scott, 2009).

Industrial peatlands and cultural ecosystem services

Undisturbed peatland landscapes have a range of ecosystem services, though quantifying them is the item of some debate (Bullock et al., 2012). Some ascribe a diverse and high number of services to intact and functioning peatlands (Kimmel and Mander, 2010), made more poignant when discussing their significant carbon sequestration potential (Waddington and Warner, 2001). However, the costs and benefits of restoring even moderately damaged peatlands are complex and challenging (Glenk et al., 2014). While industrially mined and damaged peatlands are becoming more prevalent, they have had a significant inter-association with people, communities and social institutions (Collier and Scott, 2010). Much research on peatlands has shown that humans have co-existed with mire / peat landscapes for millennia. This is evidenced by the numerous archaeological and cultural finds from all centuries, and undisturbed peatlands still retain a historical record of human activities during the same time (Novak et al., 2008), preserved in submerged plants and pollen (Bindler, 2006). In recent times, human endeavour has simultaneously destroyed the innate natural capital of many peatland systems (e.g. water holding capacity, carbon storage) but also built a new cultural and economic capital along the way (e.g. energy generation, employment). Peatlands permeate north-western European landscapes, and in all of the countries where they are located interference with hydrological and ecological functions in these landscapes has become common (Joosten and Clarke, 2002), with similar social consequences (both positive and negative). Reflecting on Irish experiences with managing peatlands since the late 1800's, table 1 contains a timeline of peatland ecosystem services from the onset of peatland mining to a projected date of 2050, i.e., from a time when they were largely un-touched through industrial extraction, and onwards to when peat extraction is complete. The information in this timeline was derived from the literature and experience of long-term research into peatland management and attempts to re-use damaged peatlands in Ireland (Bullock and Collier, 2011; Clarke and Reiley, 2010; for complete historical, botanical and management details, see: Feehan et al., 2008; Joosten et al., 2012; Kimmel and Mander, 2010; Renou et al., 2006).

Table 1. Using the Common International Classification of Ecosystem Services (CICES) classification, this table is a timeline change in industrially harvested peatlands, and speculates the future uses based on policy and planning trajectories. Red signifies the absence, decline or loss of ecosystem services and green signifies the pre-existence (on left) and the emergence (on right) of ecosystem services. This table is derived from many years of trials and research in Irish industrial peatlands.

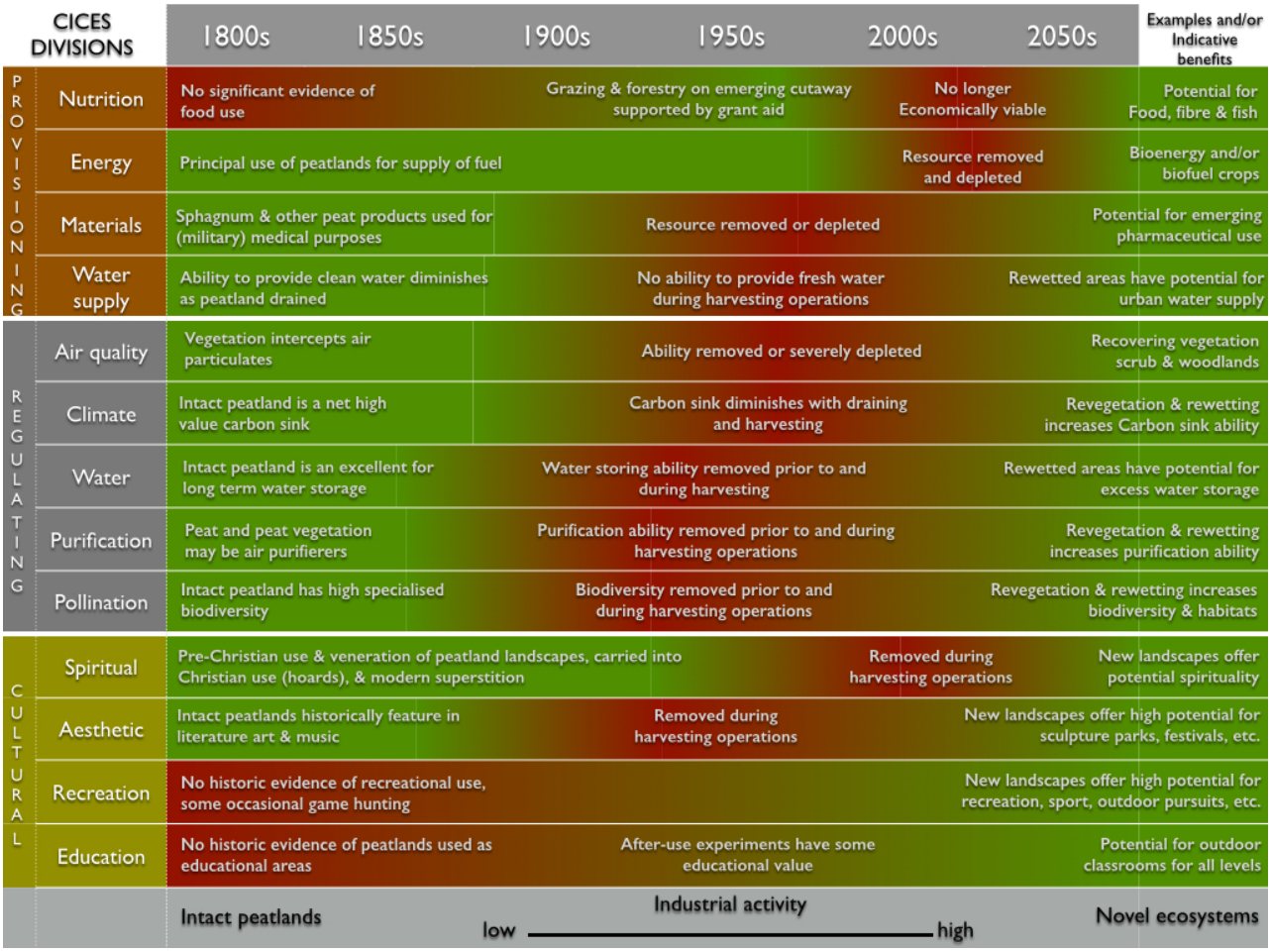

Table 1 uses the Common International Classification of Ecosystem Services (CICES) (EC 2013) to illustrate the removal of ecosystem services from intact peatlands during the industrial process, and the emerging of newer ecosystem services after cessation of extraction. During the industrial harvesting of peat an intact raised peatland is completely drained, dried and machine harvested, often to below the water table. In the process the peatland system looses key ecosystem services such as all biodiversity and all water and carbon retention capacity. As the peat mining continues deeper it becomes less and less possible to fully rehabilitate or remediate the peatland by, for example re-flooding, as the peat has lost almost all of it's vegetative cover and has become highly compacted. If industrial harvesting ceases at this point, it is likely to turn into wetlands with low ecological potential (Higgins and Colleran, 2006), and while it may eventually return to a 'natural' state, this would be in a timeframe outside current policy interest. Ultimately as human endeavour ceases, a new landscape rapidly emerges either by design (Mitsch et al., 2012) or by accident (Poulin et al., 2005), and thus there is a potential for regaining some of the lost ecosystem services (Wilson et al., 2012).

Left unmanaged for a period of time these abandoned landscapes may be classified as novel ecosystems, containing a mix of archaeophyte and neophyte species, which may ultimately perform some lost functions and services. In this way, post-industrial peatlands exemplify how a novel ecosystem may emerge. Abandonment is common and planning for active re-use and management of these abandoned landscapes often includes areas of passive, non-intrusive management that can give rise to unique (even no-analogue) habitats and further social gain. This can be said to be a novel ecosystem and while the peat will take some time to restore some of the lost services may be derived from novel ecosystem. In particular, societal expectations seek to derive differing usages from abandoned landscapes, and thus cultural ecosystem services appear to prevail and prosper in these landscapes. However, measures of many socio-cultural ecosystem services are difficult to elucidate (Milcu et al., 2013). Here, some of these values were derived from disparate sources (archaeology, art, religion, music, etc.) where critical analysis follows differing research methodologies and descriptions. Other supposed cultural ecosystem services, such as 'inspiration', 'sense of place' and 'cultural heritage', are likely to have a high value within intact peatland (and indeed all) landscapes, but these have yet to be quantified. An exception of 'social relations', where it is shown that modern communities living within industrial peatlands have associated high social values to these post-mining, recovering landscapes (Collier and Scott, 2008).

Discussion

If biodiversity is a pivotal component for maintaining both ecosystem services and resilient ecosystems then it follows that novel ecosystems may also have a similar role to play, though on a different scale and trajectory (Mace et al., 2012). They may not be considered as biodiverse as their antecedents, but novel ecosystems may have greater import when located close to or within urbanised landscapes (Kowarik, 2011). Societal expectations are a strong driver of policy, and since most landscapes may be considered to be anthropogenic (Marris et al., 2013) controversially contend that it may be futile for society to "cling to the comforting vision of the single historically correct timeless wilderness paradise" (p. 346). Moreover, while the Millennium Ecosystem Assessment illustrated that human well-being is increasingly dependant on ecosystem services, it does not identify whether these services are derived in historically-intact ecosystems or culturally created (i.e. novel) ecosystems.

An articulation of the social value of ecosystem services will assist efforts to garner broad public and political support for EU environment policies, including biodiversity conservation, by minimising real or perceived conflicts with social needs. Much of the valuation of ecosystem services to date has emphasised anthropocentric approaches and social choices with regard to our relationship with nature. As with any emerging paradigm, it is natural to question the suitability and

utility of the concept of novel ecosystems, but in doing so we open it to deeper scrutiny. On another lever, ecosystem service provision is a descriptive mechanism seeking to simplify nature's incomprehensible complexity to a format understandable by the wider society and policy makers. As society moves closer towards payments for ecological service provision, demands will be made on securing such things as value for money as well as other operational objectives. So, novel ecosystems may be recognised for their contribution to provisioning and regulating services, for augmenting or maintaining natural capital and for supporting land use planning and management policies within cultural landscapes. It is unknown whether or to what extent novel ecosystems may have social and cultural services in the longer term, though they may acquire them over time and under culturally specific influences, thus giving rise to new cultural ecosystem service values such as 'social relations', for example. It may be possible to derive multiple values from landscapes including novel ecosystems, and thus bridge the social-ecological interface. While we know more about some ecosystem services, there is a dearth of quantified support for cultural ecosystem services, despite the fact that these services are at the heart of collaborative approaches to land use.

It will be a very long time for post-industrial landscapes to return to the functioning ecosystems of their former times, *sensu stricto*. This complicates further analysis and discussion with respect to the potential costs and benefits of historic restoration and environmental engineering. It also illustrates the asymmetrical approach in land use change, where the focus can often be on what has been lost and not what may be gained. In looking at this one example of an ecosystem destroyed by severe land use, and then followed by abandonment, there may be parallels in other landscapes under similar trajectories. This is certainly not an argument for maintaining the *status quo* or a business-as-usual approach to land use, since it is against this approach that all current biodiversity conservation policies are aimed. It is important to recognise that the argument in favour of improving ecosystem services is not an argument for creating more novel ecosystems, as it is vital that continued degradation of existing ecosystems, however impacted they may be, needs to cease. But, it is argued here that exploring ecosystem services within novel ecosystems, set in context within a wider societal expectation, may be the control framework to approaching abandoned and degraded landscapes.

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