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The differences between rewilding and restoring an ecologically degraded landscape

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Abstract

1. Rewilding is a developing concept in ecosystem stewardship that involves reorganizing and regenerating wildness in an ecologically degraded landscape, with present and future ecosystem function being of higher consideration than historical benchmark conditions. This approach differs from ecosystem restoration but the two concepts are often conflated because (i) they both rely on similar management actions (at least initially) and (ii) it can be erroneously assumed that they both aim for similar states of wildness.
2. Rewilding and restoring both influence biodiversity, and common management actions such as species reintroductions (e.g. beavers or wolves) can be integral to a rewilding project. However, in contrast with restoration, rewilding has lower fidelity to taxonomic precedent and promotes taxonomic substitutions for extinct native species that once underpinned the delivery of key ecological functions.
3. We suggest the adaptive cycle as the appropriate conceptual framework in which to distinguish rewilding from ecosystem restoration. The focus of restoration ecology is to return an ecosystem to as close to its former state as is possible after a major disturbance, by directly reinstating it on the 'foreloop' of the adaptive cycle. In contrast, rewilding draws from the 'backloop' by promoting reorganization and redevelopment of the ecosystem under changing environmental conditions. If environmental conditions have changed so significantly that a regime shift is inevitable, then rewilding can facilitate the development of a novel ecosystem to sustain the provision of ecosystem services.
4. *Synthesis and applications*. Rewilding and restoring both have their places in biodiversity conservation. In each case, their respective merits should be weighed in relation to stakeholder priorities, prevailing and predicted environmental conditions, the level of biological organization targeted for management, and existing and future management capacity. We provide simple schematic decision-pathways to assist in exploring whether an ecologically degraded landscape might be a candidate for restoration, active rewilding, or passive rewilding.

KEYWORDS: adaptive cycle, biodiversity conservation, ecological restoration, ecosystem function, global change, novel ecosystems, functional traits, taxonomic substitution.

1. REWILDING VS RESTORATION: A CLASH OF PHILOSOPHY

Rewilding is a rapidly developing concept in ecosystem stewardship, highlighted by many as a potentially transformative approach to conserving and promoting biodiversity. The concept has now entered the mainstream of ecology (Pettorelli, Durant & du Toit, 2019; Perino et al., 2019) and its multiple definitions (reviewed by Pettorelli et al., 2018) have been distilled down to their common essence, which is promoting the self-reorganization or regeneration of wildness in an ecologically degraded landscape with minimal ongoing intervention. That definition is not simple, however, because wildnesss itself is an abstract concept representing an intangibly untamed quality produced in nature. Furthermore, rewilding is often conflated with restoring, because both might involve similar management actions (such as translocations) and people can mistakenly assume that both approaches aim to reinstate similar types of wildness. In addition, the media attention drawn to Pleistocene rewilding (Donlan et al., 2006) branded rewilding as the *restoration* of Pleistocene megafauna, which was a captivating notion while it lasted, despite its impracticality on an ecologically meaningful scale (du Toit, 2019).

There is perhaps little harm in the popular media referring to rewilding as the process of bringing some wildness back to an area, whether rural or urban, in a way that conflates rewilding with restoration. Nevertheless, assuming no conceptual difference between rewilding and restoration is erroneous because each aspires to a different state of nature. Restoring implies returning something to its former condition or state, as with a revered cathedral, classic car, or desired landscape. That requires reaching agreement on what the former state actually was, achieving it through precise restoration work, and then continually maintaining the agreed state despite changing environmental conditions. In contrast, rewilding means returning wildness, which is untamed, imperfect, unruly, and always changing in ways that are not entirely predictable. Like it or not, ecosystems continually self-organize and maintain resilience by adapting to variable environmental conditions through changes in their composition, structure or functioning (Holling, 1973; Holling & Gunderson, 2002). Rewilding is thus conceptually different from restoring (Table 1). It is an adaptive approach to conserving ecological functionality under changing environmental conditions, to which historical benchmarks are less relevant than to restoring. It inherently acknowledges and promotes unpredictability, while placing the emphasis on function over species composition. It uses a variety of management actions that can include taxonomic substitutions, meaning introductions of proxies for extinct species (Bakker & Svenning, 2018), and so fidelity to taxonomic precedent is more flexible than with restoring. In principle, taxonomic substitution could prioritize functionally appropriate exotic species facing conservation threats in their native ranges, although in practice less controversial options—such as various livestock breeds—are more common. Rewilding can also be applied in urban and rural areas, being inclusive of the agency of people in nature.

TABLE 1. A comparison of restoring and rewilding at the landscape scale, expressed in relation to a set of distinguishing attributes.

Distinguishing attributes	Restoring	Rewilding
Relevance of historical benchmarks	Higher	Lower
Fidelity to taxonomic precedent	Higher	Lower
Predictability of system dynamics	Higher	Lower
Management commitment	Continuous	Tapered
Motivation for translocations	Species composition	Functional type composition
Taxonomic substitutions	Resisted	Accepted
Environmentally-driven system transformation	Resisted	Accepted
Emergence of novel ecosystems	Resisted	Accepted
People and nature	More exclusive	More inclusive

Rewilding can operate at multiple levels from genes to ecosystems, and managers can achieve rewilding in several ways such as facilitating gene flow, translocating propagules or whole organisms, conducting civil engineering, or combinations thereof. For example, genetic rescue (Whiteley, Fitzpatrick, Funk & Tallmon, 2015) involves facilitating gene flow into a population facing extinction due to inbreeding depression, which might be called restoration (e.g. Johnson et al., 2010) but is actually rewilding at the molecular level. The recipient gene pool becomes reorganized with a new diversity of alleles including some that were never there before, after which the success or failure of the exercise is out of the managers' hands. It depends on the genetic and demographic viability of the 'rescued' population under changing environmental conditions (Hedrick, Adams & Vucetich, 2011). At the other extreme, the Oostvaardersplassen in the Netherlands is an example of rewilding arising from a major civil engineering project. It involved dykes, polders and pumps to expose an area of former seabed for colonization by terrestrial species, among which some were introduced and some continue to arrive unassisted (Marris, 2009). In all cases, the system is continually self-organizing as the environment changes, and the functional composition of the system is a higher consideration than the taxonomy of its operating components (e.g. Garrido et al., 2019).

2. THE POWER OF METAPHORS

The effective communication of science, especially to non-scientists, depends on the use of metaphors (Olson, Arroyo-Santos & Vergara-Silva, 2019). These are verbal and graphical models used as cognitive tools to assist in expressing, understanding, exploring, and developing complex concepts. They do have their limitations, however, and so should be used as aids and never interpreted as true and full representations. Here we offer two metaphors to help in differentiating between restoring and rewilding, with full recognition that neither can represent all the complexities and dynamics of ecosystems.

2.1. The adaptive cycle as a distinguishing conceptual framework

The adaptive cycle (Holling & Gunderson, 2002), which is a widely successful metaphor for the dynamics of social-ecological systems (Walker, Holling, Carpenter & Kinzig, 2004), has become a valued heuristic tool in ecosystem stewardship (Chapin, Kofinas & Folke, 2009). Here, we propose the adaptive cycle as the appropriate conceptual framework in which to identify the fundamental differences between rewilding and restoring an ecologically degraded landscape (Fig. 1).

Following a major disturbance, an ecosystem generally recovers with species reassembling and biomass growing (*r* phase). Available resources become exploited, with succession leading to an increasingly connected system with mounting potential for niche occupation. This leads to the accumulation and conservation of resources in a climax state (*K* phase), with the transition from exploitation to conservation (*r*-*K*) being referred to as the 'foreloop' of the cycle. Then with the next fire, hurricane, drought, outbreak, or over-harvest, the potential and connectedness are rapidly released (Ω phase) and an unpredictable 'backloop' leads to a phase of reorganization (α phase). Depending on the response diversity conserved within each functional group (Elmqvist et al., 2003; Awiti, 2011), the freed resources then allow the ecosystem to redevelop by cycling into a new *r* phase as governed by prevailing conditions.

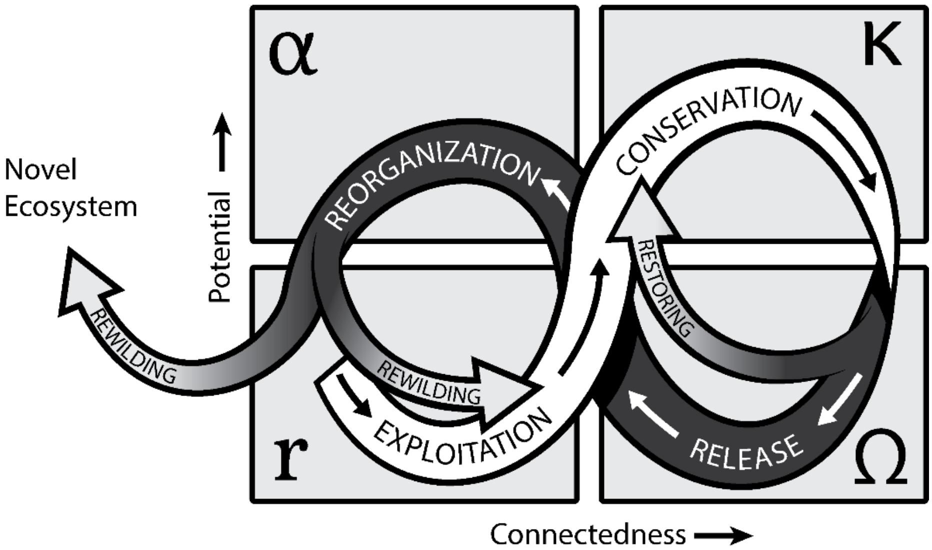

FIGURE 1. The adaptive cycle of Holling & Gunderson (2002) with arrows added for the stewardship options of rewilding and restoring, which operate at different stages within this conceptual framework

Restoration is concerned with shortcutting the backloop and fast tracking the foreloop to move the system from Ω directly back to *K* as quickly and predictably as possible after a disturbance. In contrast, rewilding draws from the backloop, facilitating reorganization and the transition from α to *r* phases so that the system can maintain resilience by adapting to changed conditions, obviating the need for continuous management. However, if the environmental conditions have changed so significantly that a regime shift is inevitable, then alternative rewilding approaches could be considered. Managers could either take a 'wait-and-see' approach (passive rewilding) as a novel ecosystem develops on its own, or intervene initially with species introductions and/or engineering works (active rewilding) to generate a novel ecosystem that might (hopefully) sustain the provision of ecosystem services under projected environmental conditions.

2.2. Classic car or enduring transport system?

Metaphors are especially helpful in understanding abstract concepts by reference to physical entities, and we venture to wield that cognitive tool to distinguish between restoring and rewilding by reference to old motor cars. This of course requires the reader to overlook the obvious inability of cars to display the adaptive, self-organizing behavior of ecosystems.

A distinctive feature of present-day Cuba is an abundance of cars of mid-20th century vintage that are still in service. From its production date, each car would have been subjected to multiple disturbances that its owners ('managers') could have responded to in various ways depending on their circumstances. When one or more essential parts failed and if original replacement parts were unavailable or unaffordable, and if there was no consideration or possibility of using non-original parts, then the car would have become derelict. Restoring would be possible if original parts could be procured and if the requisite resources and expertise could be invested in the project. Alternatively, the necessity of maintaining functionality could drive the owners to use some non-original parts and possibly adapt both vehicle and parts in the process. This would allow a valued service to be maintained in an environment with altered options, as in present-day Cuba. There, what might now appear to be a still-running classic American car could actually be powered by an engine from a Russian cement mixer with electrical wiring stripped from a Chinese washing machine. In this case, restoring is not an option in an environment of disturbance and change, so a pragmatic solution has emerged. In concept, that solution is to a transport system what rewilding is to an ecosystem.

3. MOVING FORWARD

Restoring and rewilding may be considered similar only to the extent that they both involve biodiversity and components of one could be nested within the other. For example, restoring at the species level (e.g. beavers *Castor* spp., or wolves *Canis lupus*) might be integral to rewilding at the ecosystem level (Fig. 2), but rewilding is never part of restoration. Is there value in distinguishing between these concepts and does rewilding stand alone as a viable stewardship option? We argue 'yes' because for any landscape, whether ecologically degraded or not, it is difficult to imagine how conserving biodiversity and ecosystem services could be possible in predicted future scenarios *without* rewilding. Simply stated, anthropogenic environmental forcing makes ecosystem restoration a diminishing option. That is why restoration ecologists now find themselves at a crossroads (Hobbs, 2018) where new concepts like novel and designed ecosystems (Higgs, 2017) are causing bearings to be questioned. Some suggest extending the "big tent" of restoration ecology to include these concepts (Miller & Bestelmeyer, 2018) whereas others suggest renaming restoration (Rohwer & Marris, 2016). Now, the misunderstanding of rewilding and its conflation with restoring have caused yet others to go so far as to call for banning the term rewilding ("a buzz-word") from scientific, policy, and conservation discourse (Haywood et al., 2019). Nevertheless, rewilding and restoring stand as distinct concepts, each with its own logical place within the framework of the adaptive cycle (Fig. 1). Furthermore, the distinctions between the concepts (Table 1) can assist in operationalizing the decision-making process when a group of stakeholders begins discussing a course of action for an ecologically degraded landscape (Fig. 2). In practice, the decision pathways are more likely to facilitate the process by which stakeholders muddle through to consensus than to provide a quickly adoptable roadmap towards a fixed objective. Debating priorities and exploring their implications forces stakeholders to confront environmental changes, consider how reversible (or not) they are, evaluate the costs of future commitments, and form realistic expectations.

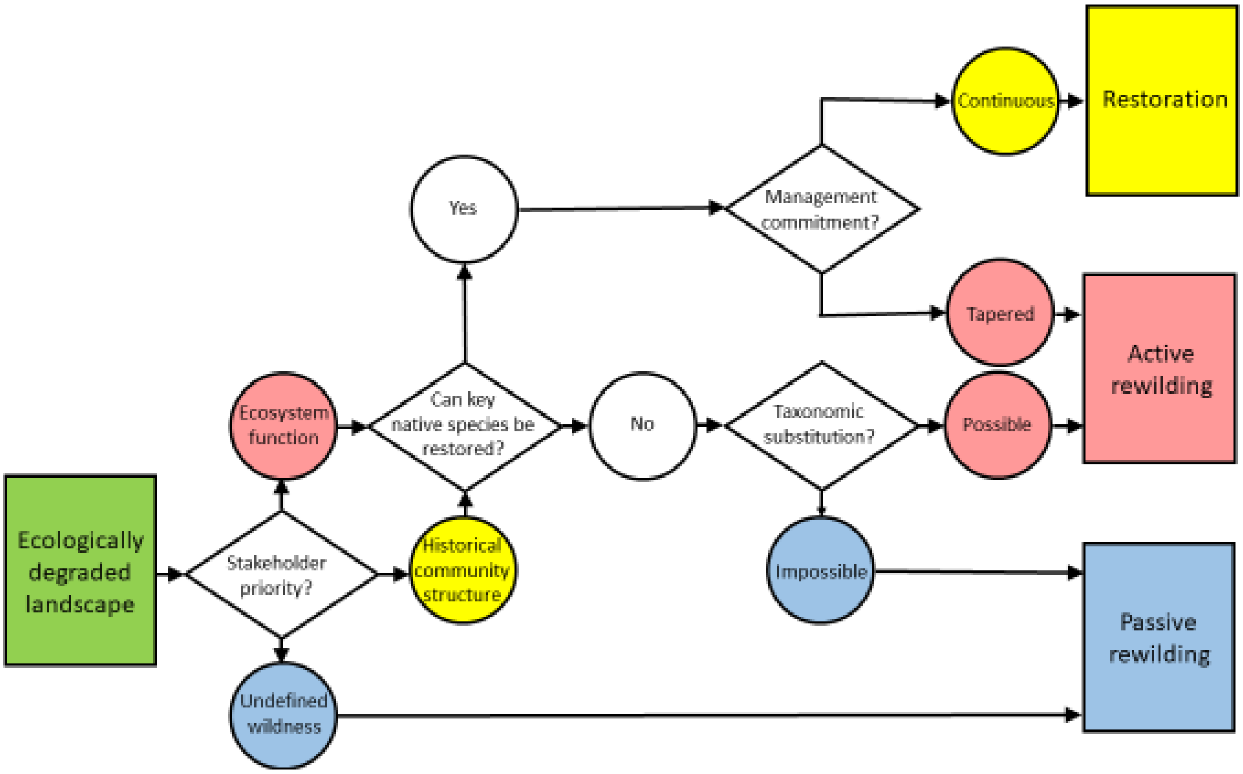

FIGURE 2. Decision pathways involved in exploring whether an ecologically degraded landscape might be a candidate for restoration, active rewilding, or passive rewilding.

4. CONCLUSIONS

Rewilding is a concept that embraces new opportunities and provides a way forward for ecologically degraded landscapes when restoration is not an option. As with rethinking an argument, retooling a factory, or reorganizing an institution, rewilding a landscape is a progressive response to the need for enhanced functionality under changed conditions. Rewilding and restoring are thus different concepts and each has its place in ecosystem stewardship. In each case, the respective merits should be weighed in relation to stakeholder priorities, prevailing and predicted environmental conditions, the level of biological organization targeted for management, and existing and future management capacity (Fig. 2). Because rewilding focuses on processes and functions, the approach challenges conservation scientists and managers to consider *why* a functional type is important before worrying about *which* species should or should not be present. This type of thinking is also developing in theoretical ecology, with a growing number of studies highlighting the importance of functional trait distribution for ecosystem processes and services (Duncan, Thompson & Pettorelli, 2015). Such ideas are disconcerting to those who argue that rewilding should focus exclusively on biodiversity and consider ecosystem services only as co-benefits (Genes et al., 2019). Wild ecosystems are, however, as diverse as their environmental constraints allow, while processes and functions are part of biodiversity anyway. Therefore any rewilding project, whether initiated for ecosystem services or not, will ultimately promote local biodiversity. Indeed, the rise of the rewilding concept is a sign that pragmatic new approaches are urgently needed to conserve both biodiversity and ecosystem services under rapidly changing environmental conditions.

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AUTHORS’ CONTRIBUTIONS

JTdT and NP conceived the ideas, wrote the paper, and gave final approval for publication.

DATA ACCESSIBILITY

There are no data involved in this paper and so none are archived.

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